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WATER POLLUTION SURVEILLANCE SYSTEM APPLICATION NO. 24. AN ATLAS OF WATER POLLUTION SURVEILLANCE IN THE UNITED STATES, OCTOBER 1, 1957 TO SEPTEMBER 30, 1965

Charles G. Gunnerson

Federal Water Pollution Control Administration
Cincinnati, Ohio

21 December 1966

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WATER POLLUTION SURVEILLANCE SYSTEM
APPLICATION AND DEVELOPMENT REPORT #24

AN ATLAS OF WATER POLLUTION SURVEILLANCE IN THE UNITED STATES, OCTOBER 1, 1957 TO SEPTEMBER 30, 1965

BY

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Federal Water Pollution Control Administration
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Cincinnati, Ohio

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AN ATLAS OF POLLUTION SURVEILLANCE IN THE UNITED STATES
OCTOBER 1, 1957 TO SEPTEMBER 30, 1965

INTRODUCTION

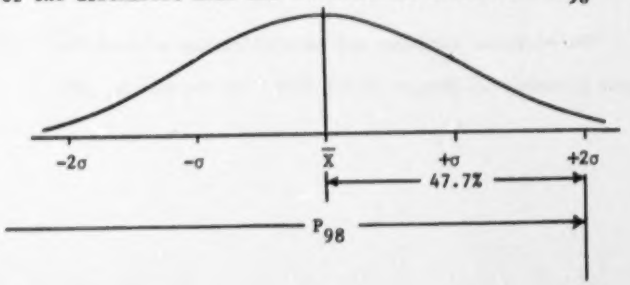
This atlas is based upon information in, and is intended as a supplement to, the Water Pollution Surveillance System Summary Compilation of Data, October 1, 1963 to September 30, 1965, scheduled for publication early in 1967. It is designed as a summary and graphical aid to the interpretation of individual numerical values presented in this and earlier compilations. Only those aspects of the sampling program and analytical procedures which are unique to the preparation of this atlas are discussed herein; the reader is referred to the appropriate compilation volume for more detailed information.

Although the period covered by this atlas is from the beginning of federal water pollution surveillance operations on October 1, 1957 through the end of Water Year 1965, the period of record for any particular station will be in accord with the activation date for that station. A numerical listing of pollution surveillance stations and their activation dates is presented in Table 1.

Figure 1 shows the locations and identifying numbers of the 131 FWPCA Water Pollution Surveillance System stations which were in operation September 30, 1965.

The most useful statistic which describes water quality in streams and other surface waters is the mean concentration. For chemical and physical constituents, the arithmetic mean ($\bar{X} = \frac{x_1 + x_2 + \ldots + x_n}{n}$) has been used. For biological characterization, particularly in concentrations of coliform bacteria and of plankton, the geometric mean ($\bar{X}_g = \sqrt[n]{x_1 \cdot x_2 \cdot \ldots \cdot x_n}$) is used as a more realistic measure of central tendency.

Although physical characteristics are often summarized in terms of ranges, it must be pointed out that variations in concentrations of chemical constituents are due to changes in season, biological activity and streamflow as well as waste discharges. A useful measure of both the variability and the concentrations which represent a practical upper limit is the 98-Percentile. This value (actually the 97.7 percentile) is obtained from the mean and the standard deviation. In this atlas, normal distributions are assumed and the 98-Percentile for physical and chemical constituents is the sum of the arithmetic mean and two standard deviations ($P_{98} = \bar{X} + 2\sigma$).



An example of the relationship and usefulness of the mean and 98-Percentile information follows: in Figure 33 we note that at Station No. 57, Chattahoochee, Florida on the Apalachicola River (see Table 1 and Figure 1) the mean strontium-90 concentration for all samples taken during the period of record falls between 1.0 and 1.5 pc/1. From the adjoining map on Figure 33 we find that 98% of the concentration values for the period of record were below a point within the range 2.0 to 3.3 pc/1.

Biological factors characteristically show very wide ranges in concentrations, generally several orders of magnitude. A direct measure of this variability is the geometric standard deviation which is a ratio, in contrast to the arithmetic standard deviation which is a difference. The 98-Percentile level for coliform bacteria and for plankton is the product of the geometric mean and the square of the geometric standard deviation ($P_{98} = \overline{X}_g \cdot \sigma^2$). Here a log-normal distribution is assumed. This criterion is not always met, particularly with coliform bacteria where widely differing pollution sources, for example, sewage and runoff, occasionally result in skewed or even bimodal distributions. In such cases, information on the maximum observed level is often useful.

The plankton sampling and identification program has undergone a number of changes since 1957. On October 1, 1961 a new presentation scheme was adopted and the period of record summarized in this atlas is modified accordingly.

In preparing this atlas, four levels of concentration or activity have been determined, corresponding generally to quartile ranges. For example, approximately one-fourth of the 131 values shown on Figure 2 for the mean coliform bacteria concentration were less than 100 per 100 ml; one-fourth were from 100 to 1,000 per 100 ml and so on. In those cases where the constituent is included in the U. S. Public Health Service Drinking Water Standards, the prescribed value for that constituent is selected as one of the limits.

The trace elements determined by spectrographic analysis present a special case. The limiting sensitivity of the instrument for a particular sample is inversely proportional to the dissolved solids concentration. Thus, the lowest level at which molybdenum could be detected ranged from 2 µg/1 in the Truckee River at Farad to 200 µg/1 in the Raritan River at Perth Amboy. When no measureable quantities were found, corresponding concentrations were reported as <2 µg/1 or as <200 µg/1. It is not possible to average discrete values with less-than values. Consequently, data on trace elements are summarized by presenting the mean of positive identifications, the maximum observed concentration, and the percentage of samples which contained measureable quantities of the element.

In addition to the trace-element data presented on the maps, the following two items should be noted: (1) strontium was always found and (2) barium was found at no time in the Raritan River at Perth Amboy, one-third of the time in the Arkansas River at Coolidge, 90% of the time in the Missouri River at Omaha, and 100% of the time at all other stations.

Finally, maps showing occurrences of chlorinated hydrocarbon pesticides are presented. Here, concentrations are measured in the parts per trillion range. Pesticides are shown as being present, presumptive, or absent. Data are reported as presumptive in instances where the results of chromatography were highly indicative but did not meet all requirements for positive identification and quantification.

Table 1. LIST OF FWPCA POLLUTION SURVEILLANCE STATIONS, SEPTEMBER 30, 1965

Station No.	Location	Activation Date
1	Arkansas R. near Ponca City, Okla.	April 1958
2	Arkansas R. at Coolidge, Kan.	March 1958
3	Colorado R. at Yuma, Ariz.	November 1957
4	Colorado R. above Parker Dam, Ariz.-Calif.	January 1958
5	Colorado R. near Boulder City, Nev.	July 1958
6	Colorado R. at Loma, Colo.	April 1958
7	Columbia R. at Clatskanie, Ore.	April 1958
8	Columbia R. at Bonneville, Ore.	November 1957
9	Columbia R. at Pasco, Wash.	November 1957
10	Columbia R. at Wenatchee, Wash.	October 1958
11	Connecticut R. below Northfield, Mass.	June 1959
12	Delaware R. at Philadelphia, Pa.	November 1957
14	Lake Erie at Buffalo, N.Y.	November 1957
15	Detroit R. at Detroit, Mich.	November 1957
16	Lake Superior at Duluth, Minn.	October 1957
17	Lake Michigan at Gary, Ind.	October 1958
18	Hudson R. below Poughkeepsie, N.Y.	July 1958
19	Merrimack R. above Lowell, Mass.	January 1958
20	Mississippi R. at New Orleans, La.	December 1957
21	Mississippi R. at Vicksburg, Miss. 1957-1959 reactivated	May 1961
22	Mississippi R. at West Memphis, Ark.	January 1958
23	Mississippi R. at Cape Girardeau, Mo.	January 1958
24	Mississippi R. at East St. Louis, Ill.	December 1957
25	Mississippi R. at Burlington, Iowa	October 1957
26	Mississippi R. at Dubuque, Iowa	December 1957
27	Mississippi R. Lock and Dam #3 below St. Paul, Minn.	October 1957
28	Missouri R. at St. Louis, Mo.	October 1957
29	Missouri R. at Kansas City, Kan.	November 1957
30	Missouri R. at St. Joseph, Mo.	December 1957
31	Missouri R. at Omaha, Nebr.	October 1957
32	Missouri R. at Yankton, S. Dak.	October 1957
33	Missouri R. at Bismarck, N. Dak.	November 1957
34	Missouri R. at Williston, N. Dak.	November 1957
35	Ohio R. at Cairo, Ill.	April 1958
36	Ohio R. at Evansville, Ind.	January 1958
37	Ohio R. at Cincinnati, Ohio	April 1958
38	Ohio R. at Huntington, W. Va.	November 1957
40	Potomac R. at Great Falls, Md.	October 1957
41	Potomac R. at Williamsport, Md.	October 1957
42	Red R. (South) at Alexandria, La.	November 1957
43	Red R. (South) at Index, Ark.	February 1957
44	Red R. (South) at Denison, Tex.	August 1958
45	Rio Grande at Laredo, Tex.	November 1957
46	Rio Grande at El Paso, Tex.	March 1958
47	Savannah R. at Port Wentworth, Ga.	February 1958
48	Savannah R. at North Augusta, S. C.	February 1958
49	Snake R. at Wawawai, Wash.	August 1958
51	Tennessee R. at Chattanooga, Tenn.	March 1958
52	Arkansas R. at Pendleton Ferry, Ark.	March 1959
53	Arkansas R. near Fort Smith, Ark.	August 1959
54	Mississippi R. at Delta, La.	October 1958
55	Yellowstone R. near Sidney, Mont.	November 1958
56	Animas R. at Cedar Hill, N. Mex.	February 1960
57	Apalachicola R. at Chattahoochee, Fla.	December 1959
58	Chattahoochee R. at Atlanta, Ga.	May 1960
59	Chattahoochee R. at Columbus, Ga.	October 1959
60	Colorado R. at Page, Ariz.	November 1959
61	Delaware R. at Martins Creek, Pa.	November 1957
62	Escambia R. at Century, Fla.	August 1960
63	St. Lawrence R. at Massena, N.Y.	April 1960
64	St. Clair R. at Port Huron, Mich.	May 1960
65	Lake Michigan at Milwaukee, Wis.	August 1960
66	St. Mary's R. at Sault Ste. Marie, Mich.	November 1959
67	Illinois R. at Peoria, Ill.	March 1960
68	Kanawha R. at Winfield Dam, W. Va.	February 1960
69	Red R. (North) at Grand Forks, N. Dak.	September 1960
71	Rio Grande below Brownsville, Tex.	October 1959
72	Rio Grande below Alamosa, Colo.	November 1960
73	Sabine R. near Ruliff, Tex.	May 1960
74	Schuylkill R. at Philadelphia, Pa.	January 1960
75	Susquehanna R. at Conowingo, Md.	June 1960
76	Susquehanna R. near Sayre, Pa.	February 1960
77	Tennessee R. at Bridgeport, Ala.	October 1960
78	Klamath R. near Keno, Ore.	November 1960
79	Allegheny R. at Pittsburgh, Pa.	February 1961
80	Big Sioux R. below Sioux Falls, S. Dak.	May 1961
81	Columbia R. at McNary Dam, Ore.	April 1961
82	Connecticut R. at Enfield Dam, Conn.	July 1962
83	Monongahela R. at Pittsburgh, Pa.	June 1961
84	Ohio R. at Louisville, Ky.	June 1961

Table 1. LIST OF FWPCA POLLUTION SURVEILLANCE STATIONS, SEPTEMBER 30, 1965
(CONTINUED)

Station No.	Location	Activation Date
85	Ouachita R. at Bastrop, La.	August 1961
86	Platte R. above Plattsmouth, Nebr.	August 1961
87	Shenandoah R. at Berryville, Va.	June 1961
88	Truckee R. at Farad, Calif. below Calif.-Nev. Border	September 1961
89	Yakima R. at Richland, Wash.	May 1961
90	Little Miami R. at Cincinnati, Ohio	October 1960
91	Roanoke R. at John Kerr Reservoir and Dam, Va.	June 1961
92	South Platte R. at Julesburg, Colo.	June 1961
93	San Juan R. at Shiprock, N. Mex.	August 1961
94	North Platte R. above Henry, Nebr.	August 1961
95	Tombigbee R. below Columbus, Miss.	September 1961
96	Rainy R. at Baudette, Minn.	September 1961
97	Clearwater R. at Lewiston, Ida.	October 1961
98	Illinois R. at Grafton, Ill.	October 1961
99	Tennessee R. at Pickwick Landing Dam, Tenn.	October 1961
100	Delaware R. at Trenton, N. J.	November 1961
101	Rainy R. at International Falls, Minn.	November 1961
102	Snake R. at Payette, Ida.	October 1961
103	Connecticut R. at Wilder, Vt.	December 1961
104	Big Horn R. at Hardin, Mont.	December 1961
105	Wabash R. at New Harmony, Ind.	January 1962
106	Clinch R. above Kingston, Tenn.	January 1962
107	Tennessee R. at Lenoir City, Tenn.	January 1962
108	Missouri R. at Missouri City, Mo.	January 1962
109	Verdigris R. at Nowata, Okla.	March 1962
110	Ship Creek at Anchorage, Alas.	June 1962
111	Chena Slough at Fairbanks, Alas.	June 1962
112	Columbia R. at Northport, Wash.	May 1962
113	Pend Oreille R. at Albeni Falls Dam, Ida.	May 1962
114	Spokane R. at Post Falls Dam, Ida.	May 1962
115	Snake R. at Ice Harbor Dam, Wash.	May 1962
116	Sacramento R. at Green's Landing above Courtland, Calif.	May 1962
117	Ohio R. below Addison, Ohio	June 1962
118	Red R. at Bossier City, La.	June 1962
119	Clinch R. at Clinton, Tenn.	June 1962
120	Chattahoochee R. at Lanett, Ala.	June 1962
121	Green R. at Dutch John, Utah	July 1962
122	San Joaquin R. near Vernalis, Calif.	June 1962
123	Raritan R. at Perth Amboy, N.J.	June 1962
124	Willamette R. at Portland, Ore.	August 1962
125	Bear R. above Preston, Ida.	August 1962
126	Cuyahoga R. at Cleveland, Ohio	December 1962
127	Maumee R. at Toledo, Ohio	October 1962
128	Kansas R. at DeSota, Kan.	April 1963
129	Ohio R. at Toronto, Ohio	July 1963
130	Potomac R. at Washington, D.C.	July 1963
131	Arkansas R. at Little Rock, Ark.	July 1963
132	Atchafalaya R. at Morgan City, La.	May 1964
133	Mississippi R. near New Roads, La.	May 1964
134	Cumberland R. at Cheatham Lock, Tenn.	August 1964
135	Coosa R. below Rome, Ga.	September 1964

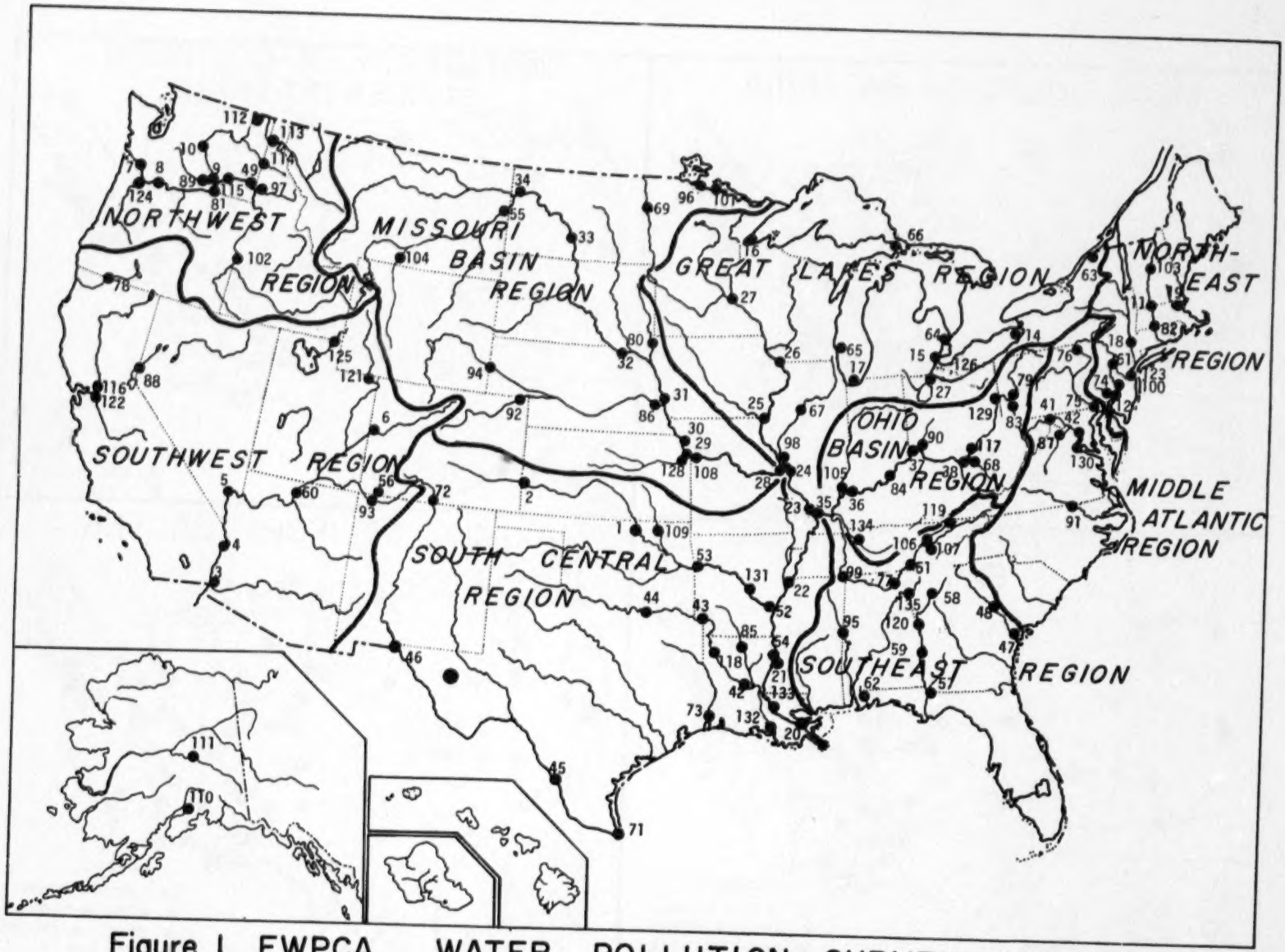


Figure 1. FWPCA WATER POLLUTION SURVEILLANCE SYSTEM, SEPTEMBER 30, 1965

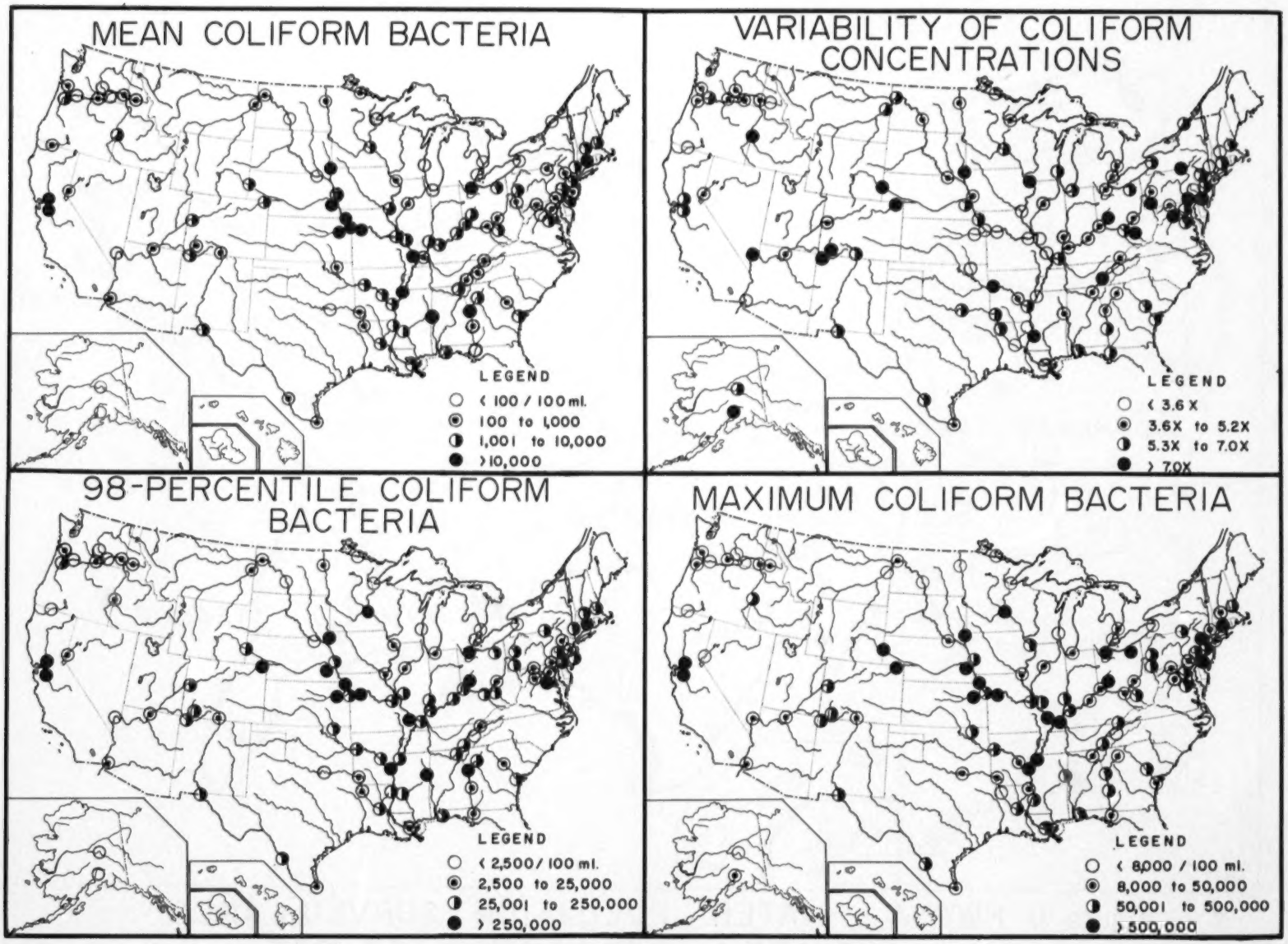


Figure 2. COLIFORM BACTERIA

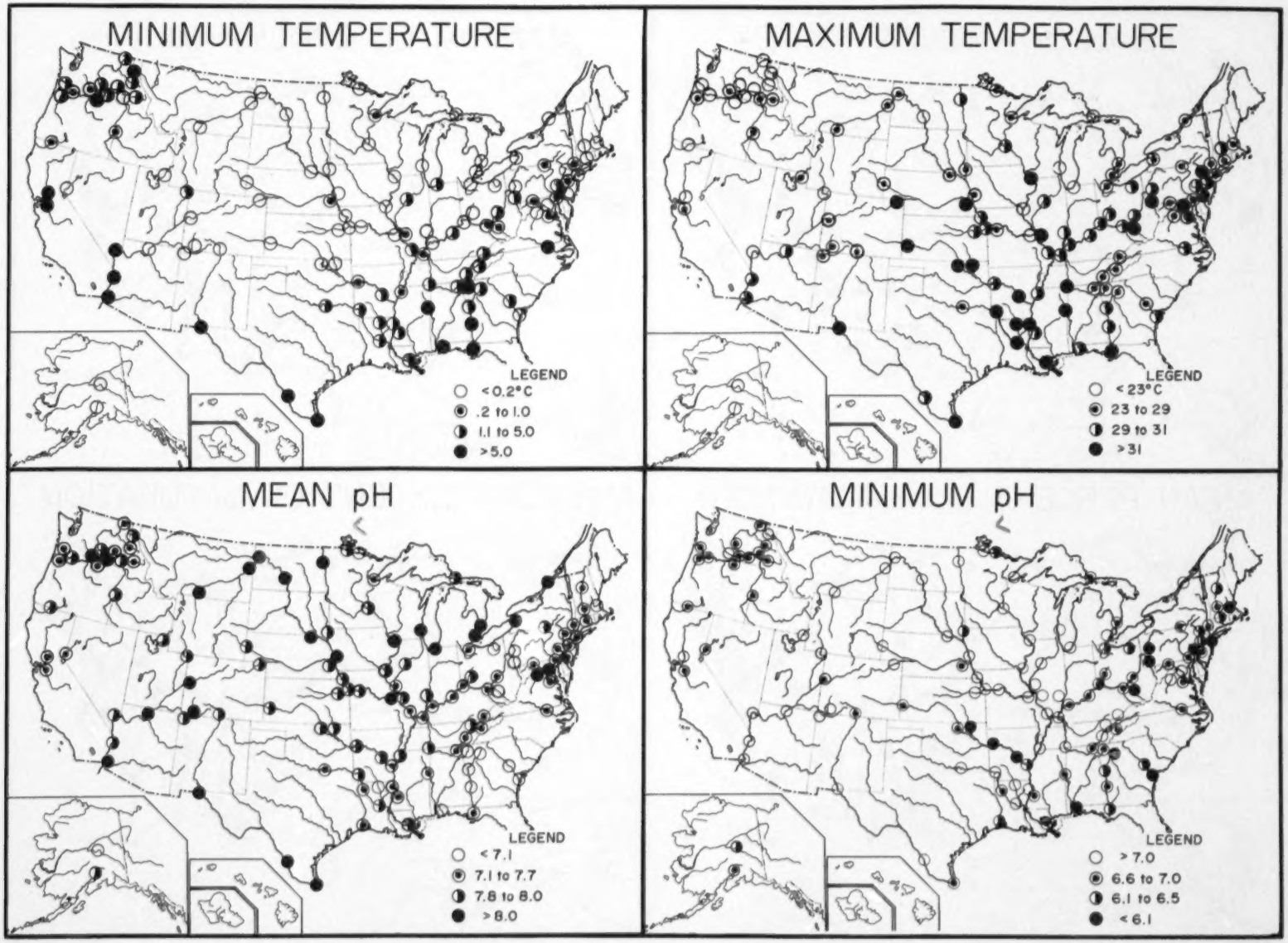


Figure 3. TEMPERATURE AND pH

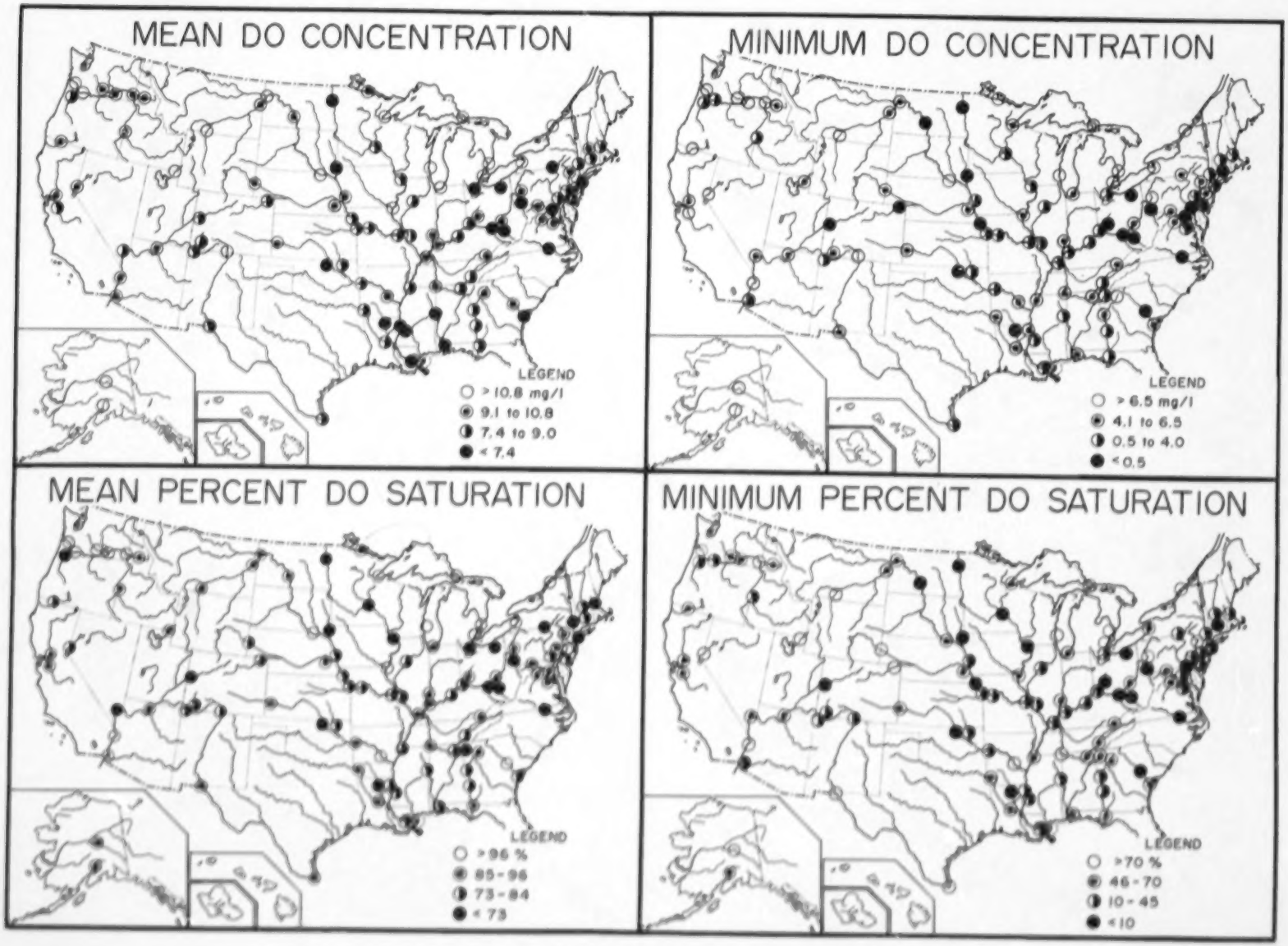


Figure 4. DISSOLVED OXYGEN

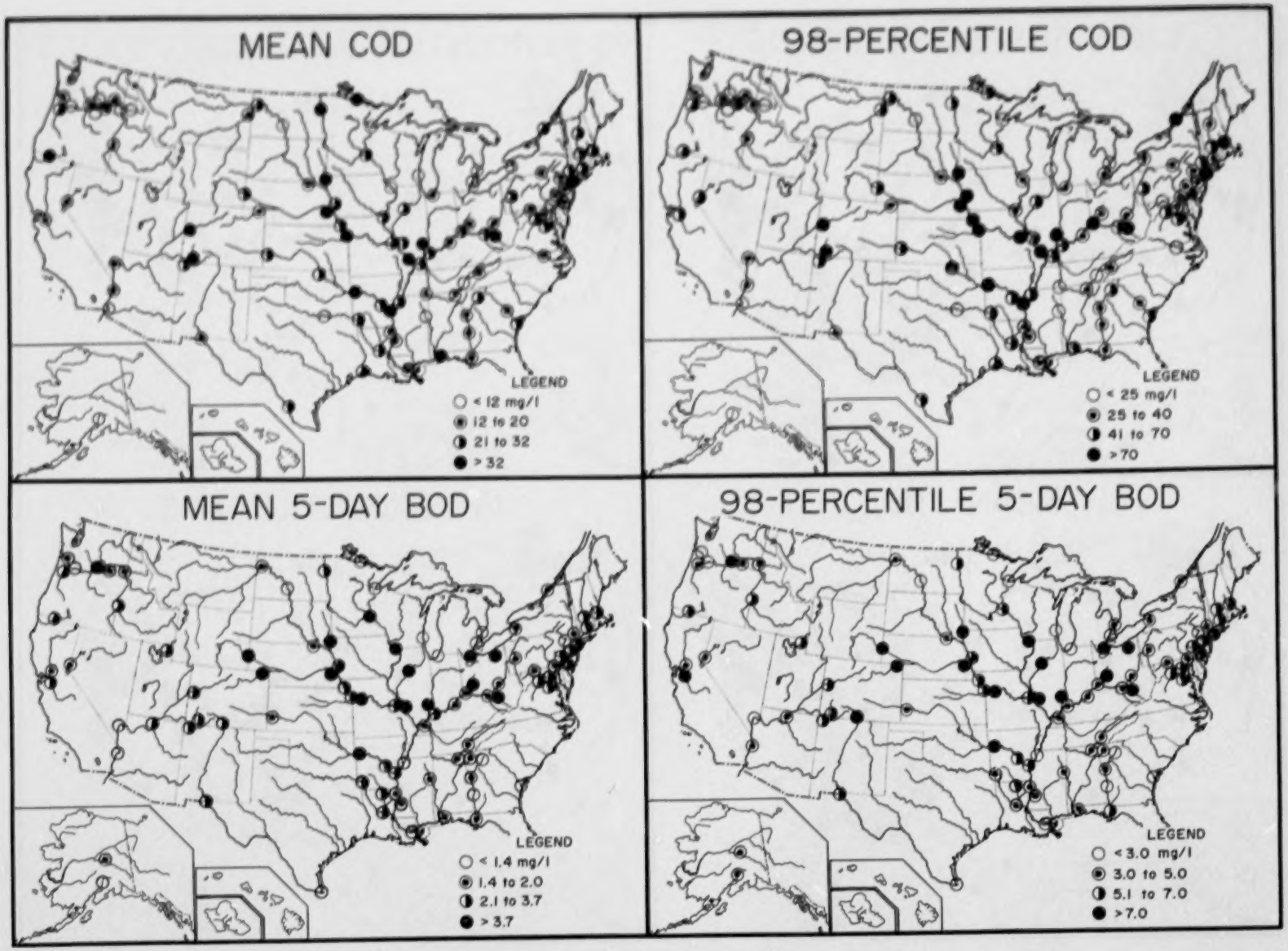


Figure 5. COD AND 5-DAY BOD

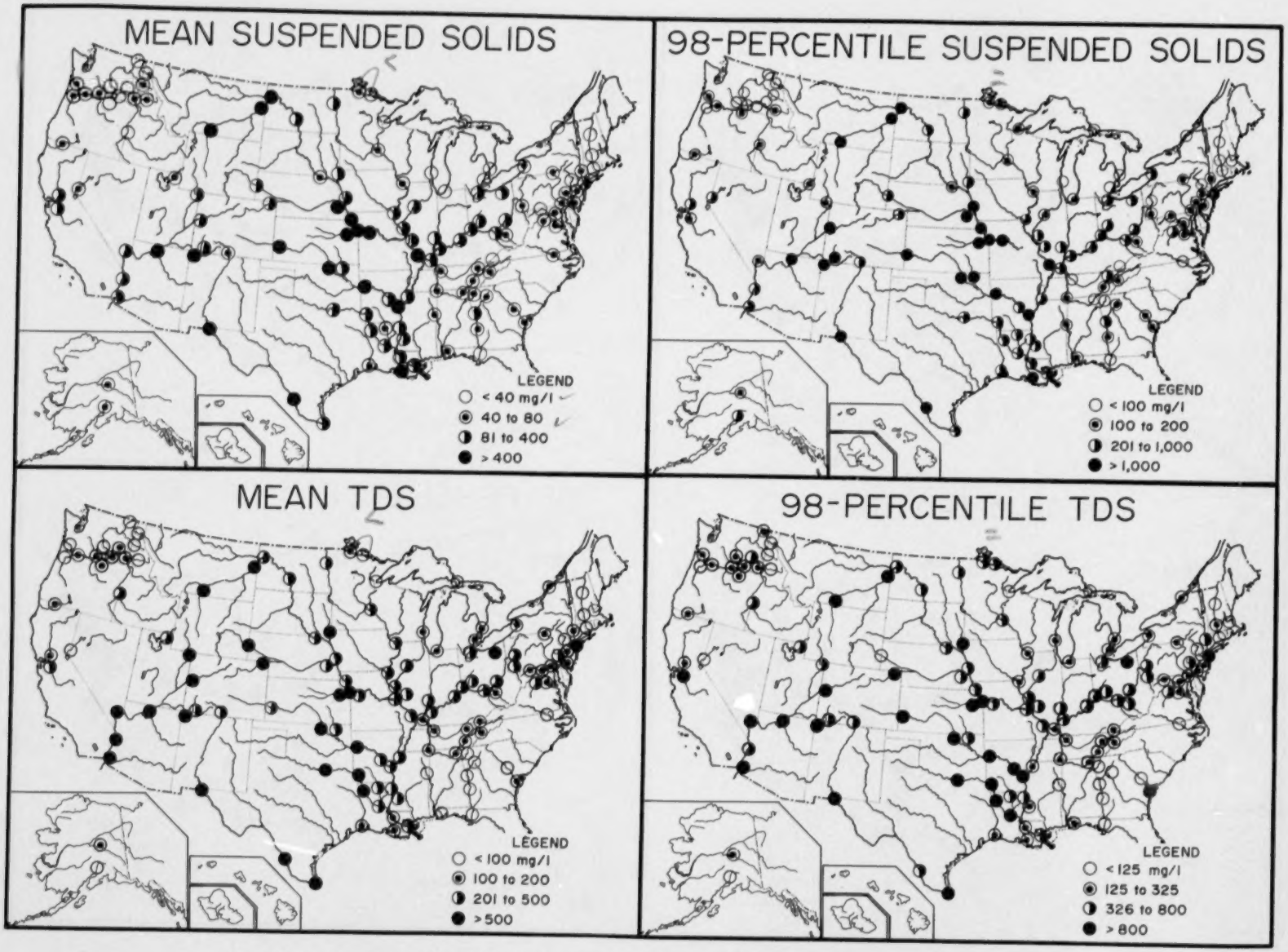


Figure 6. SUSPENDED AND DISSOLVED SOLIDS

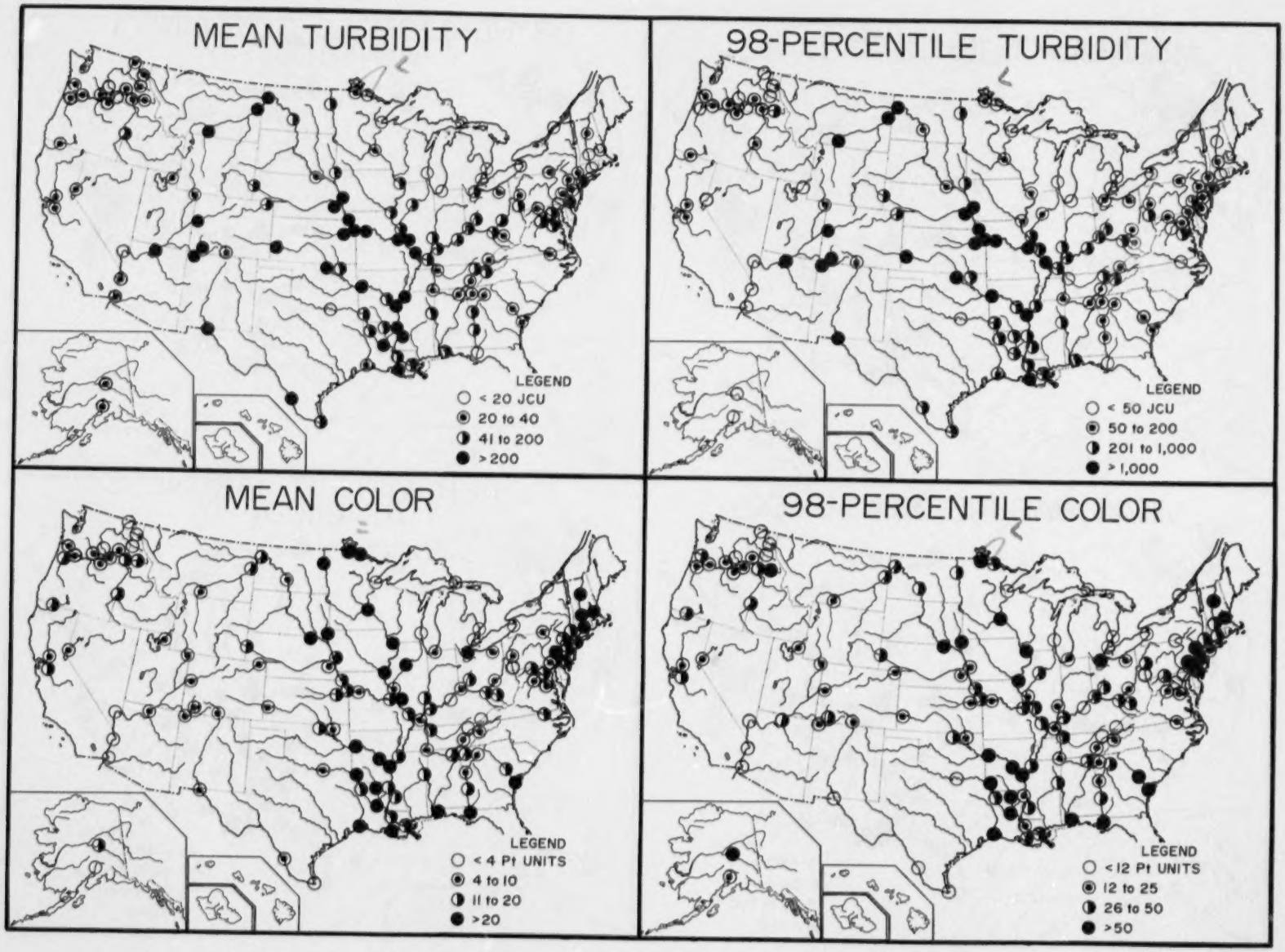


Figure 7. TURBIDITY AND COLOR

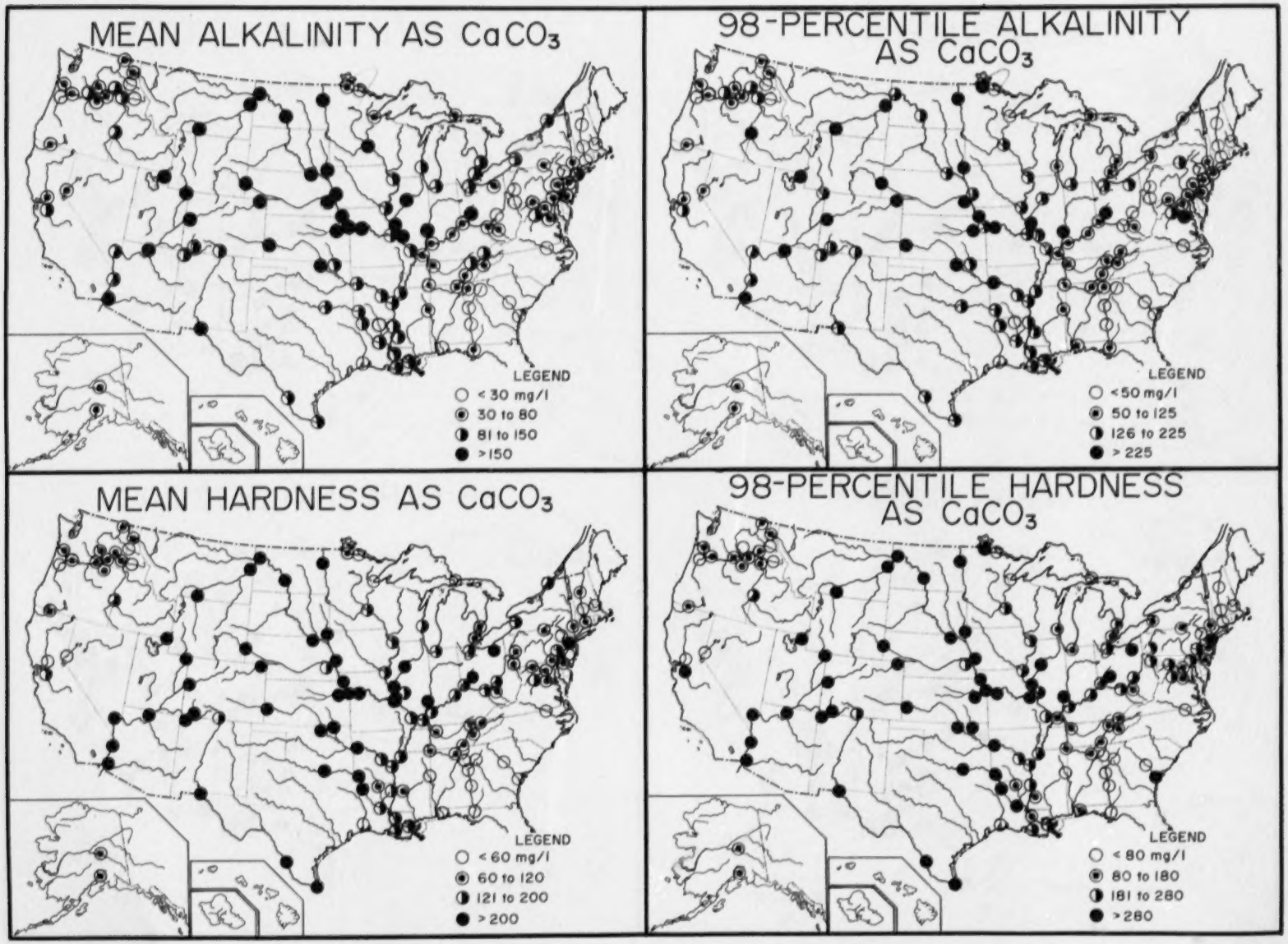


Figure 8. ALKALINITY AND HARDNESS

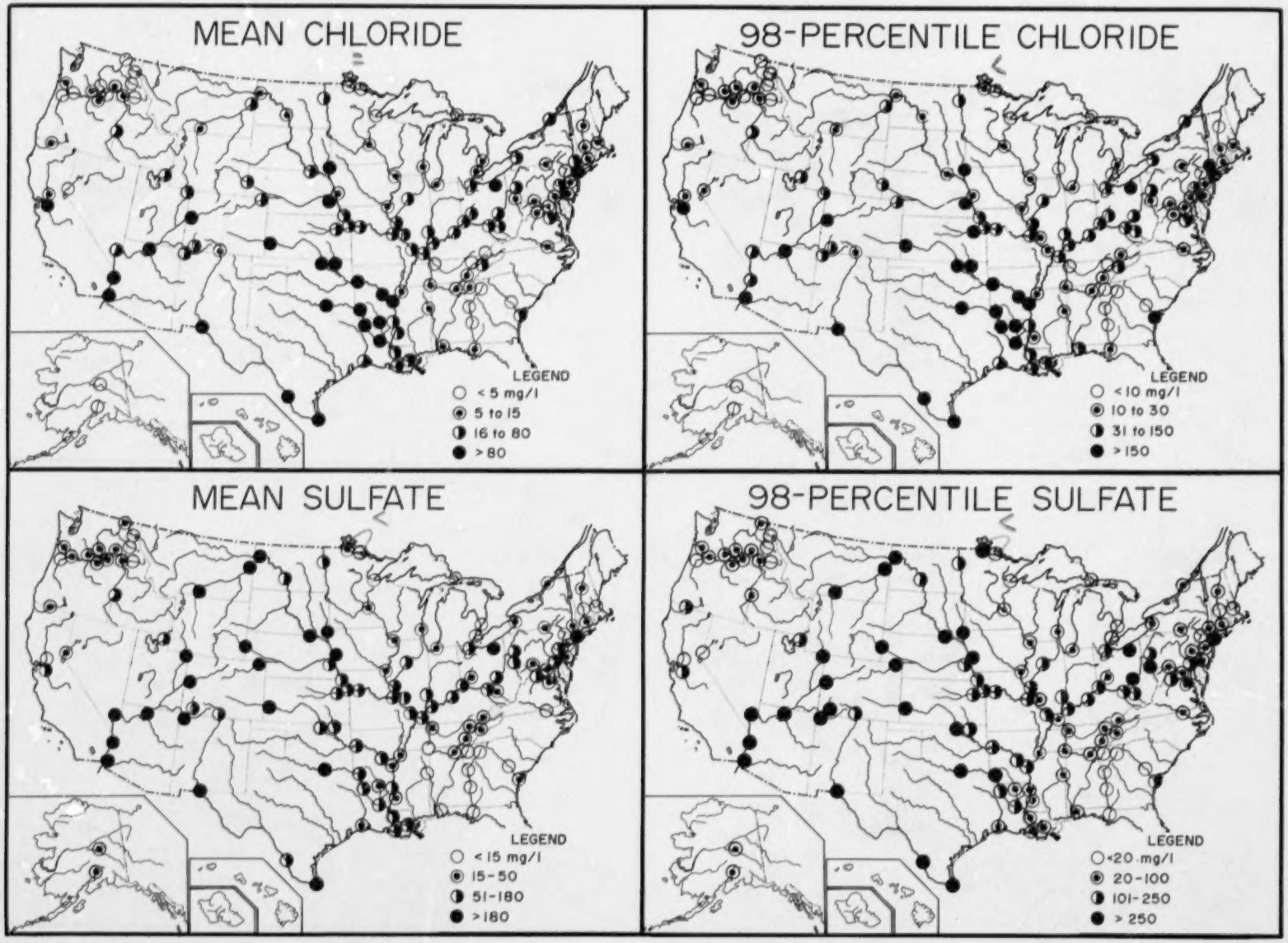


Figure 9. CHLORIDE AND SULFATE

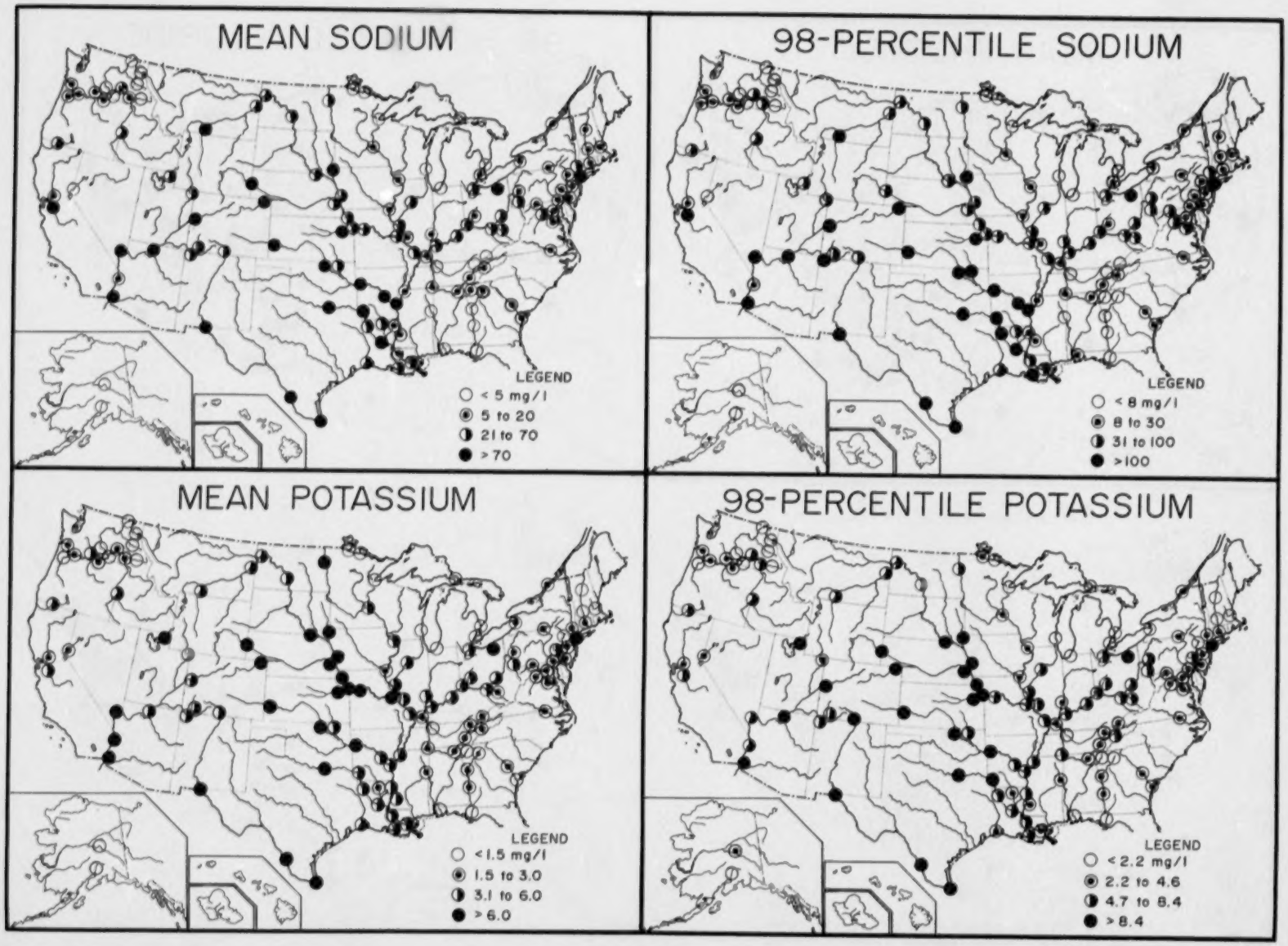


Figure 10. SODIUM AND POTASSIUM

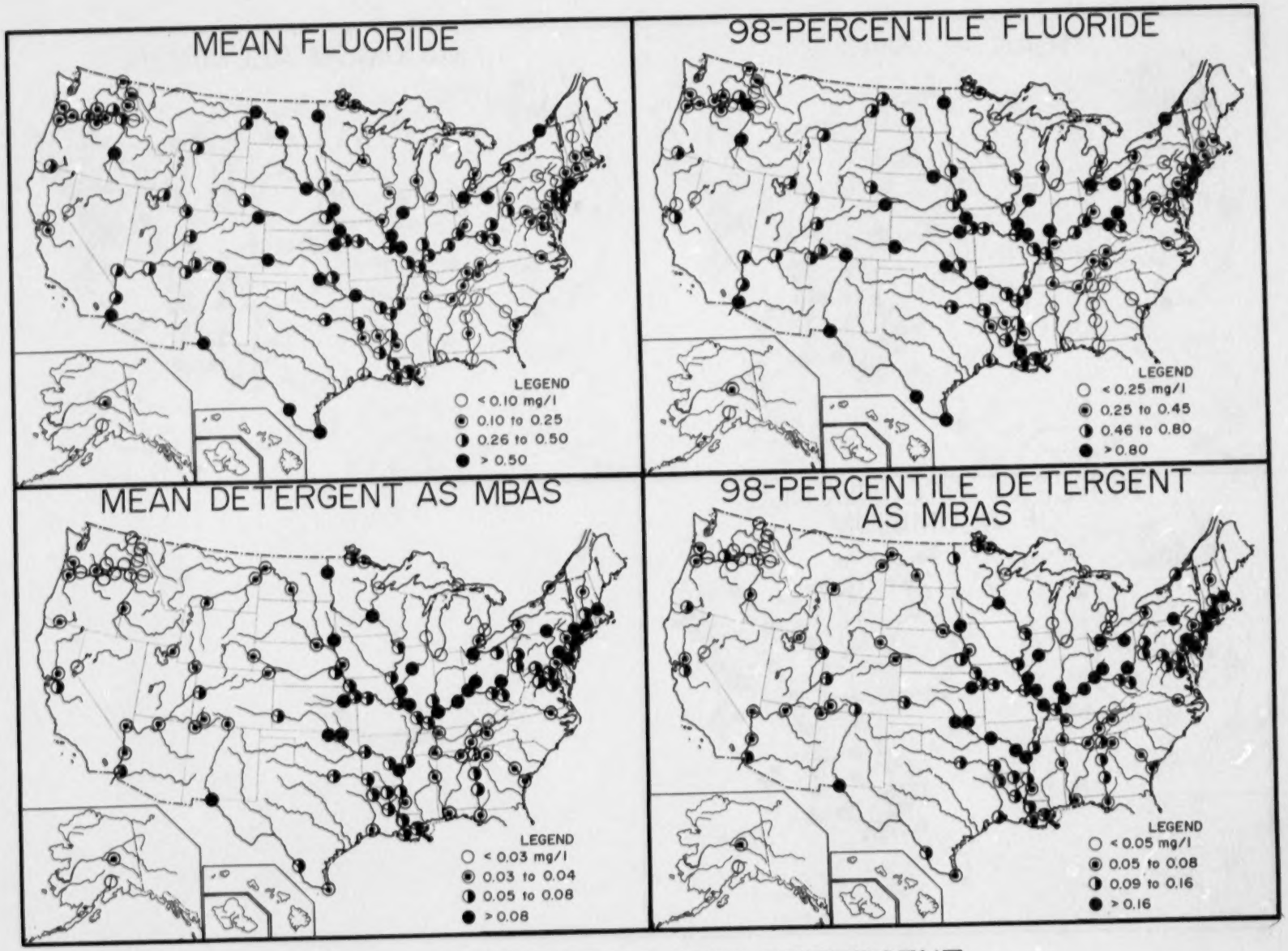


Figure II. FLUORIDE AND DETERGENT

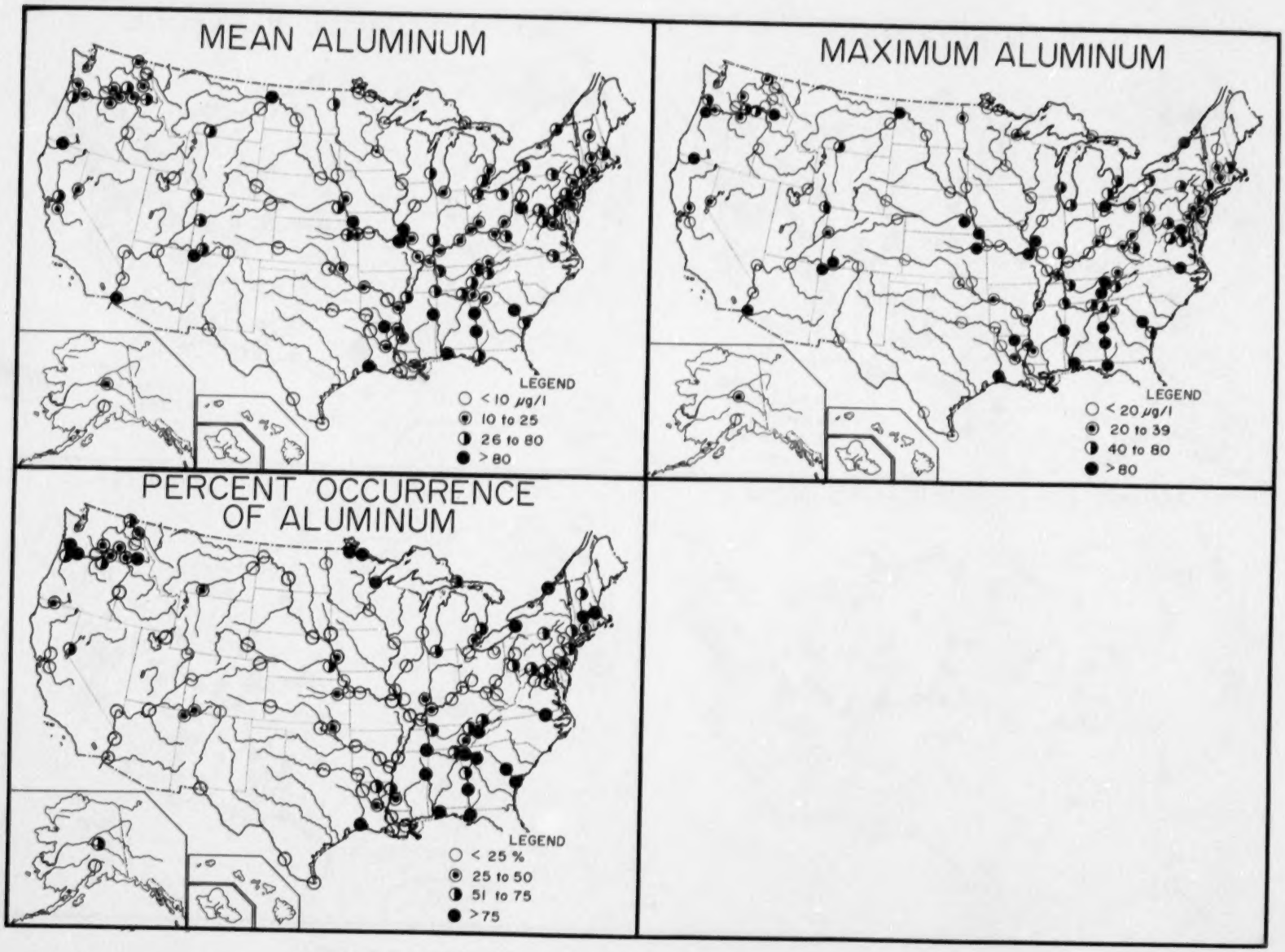


Figure 12. ALUMINUM

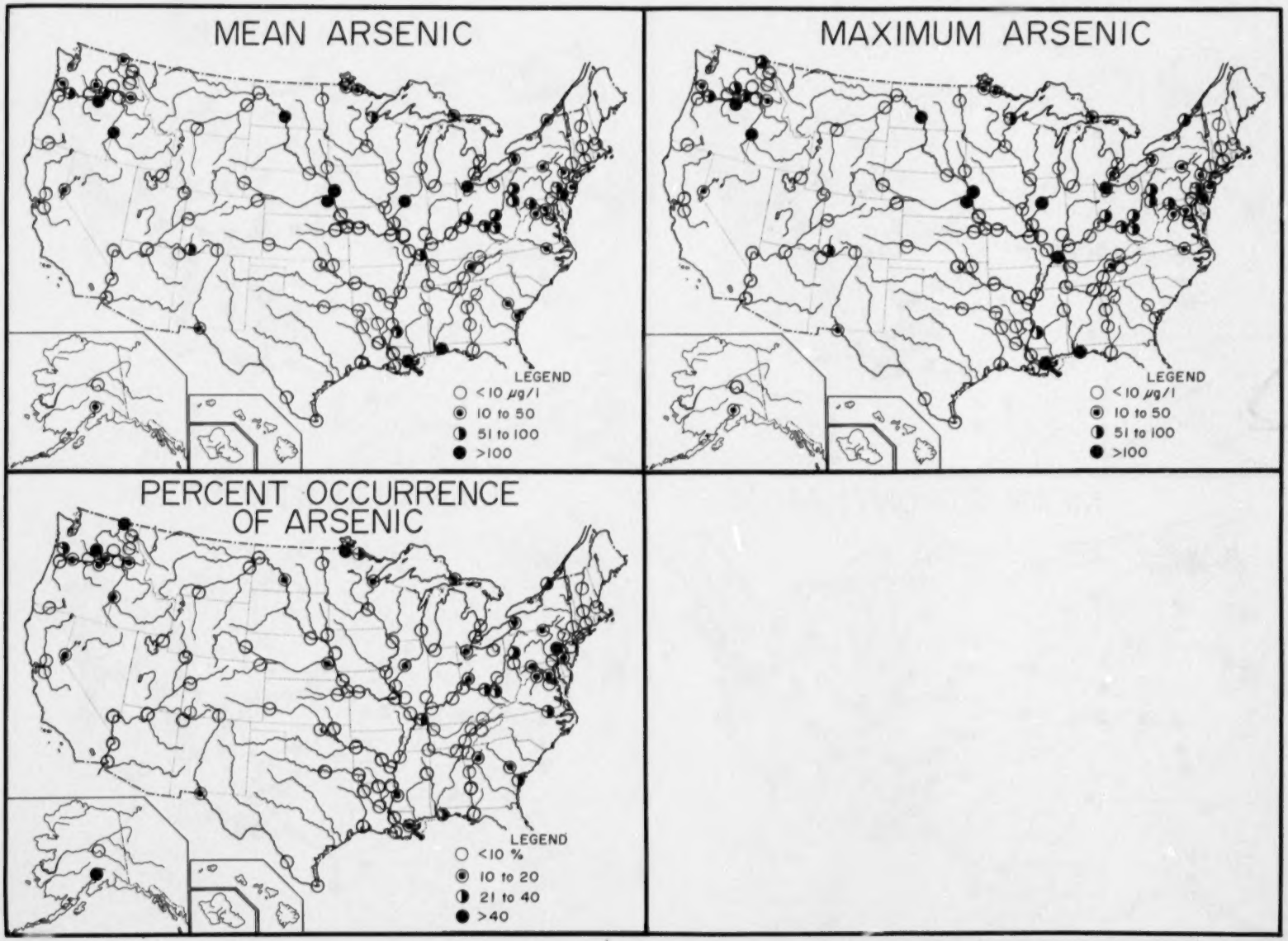


Figure 13. ARSENIC

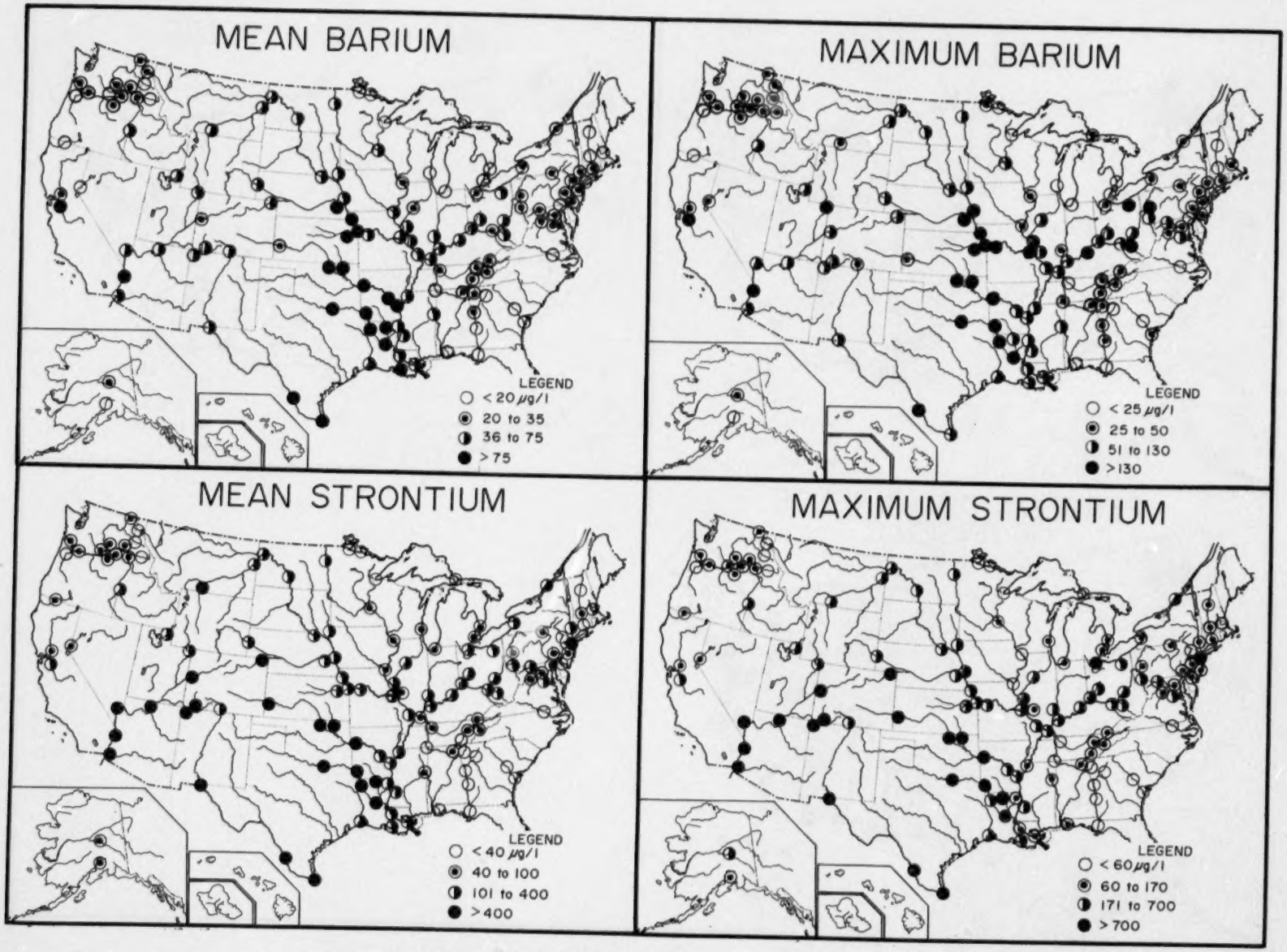


Figure 14. BARIUM AND STRONTIUM

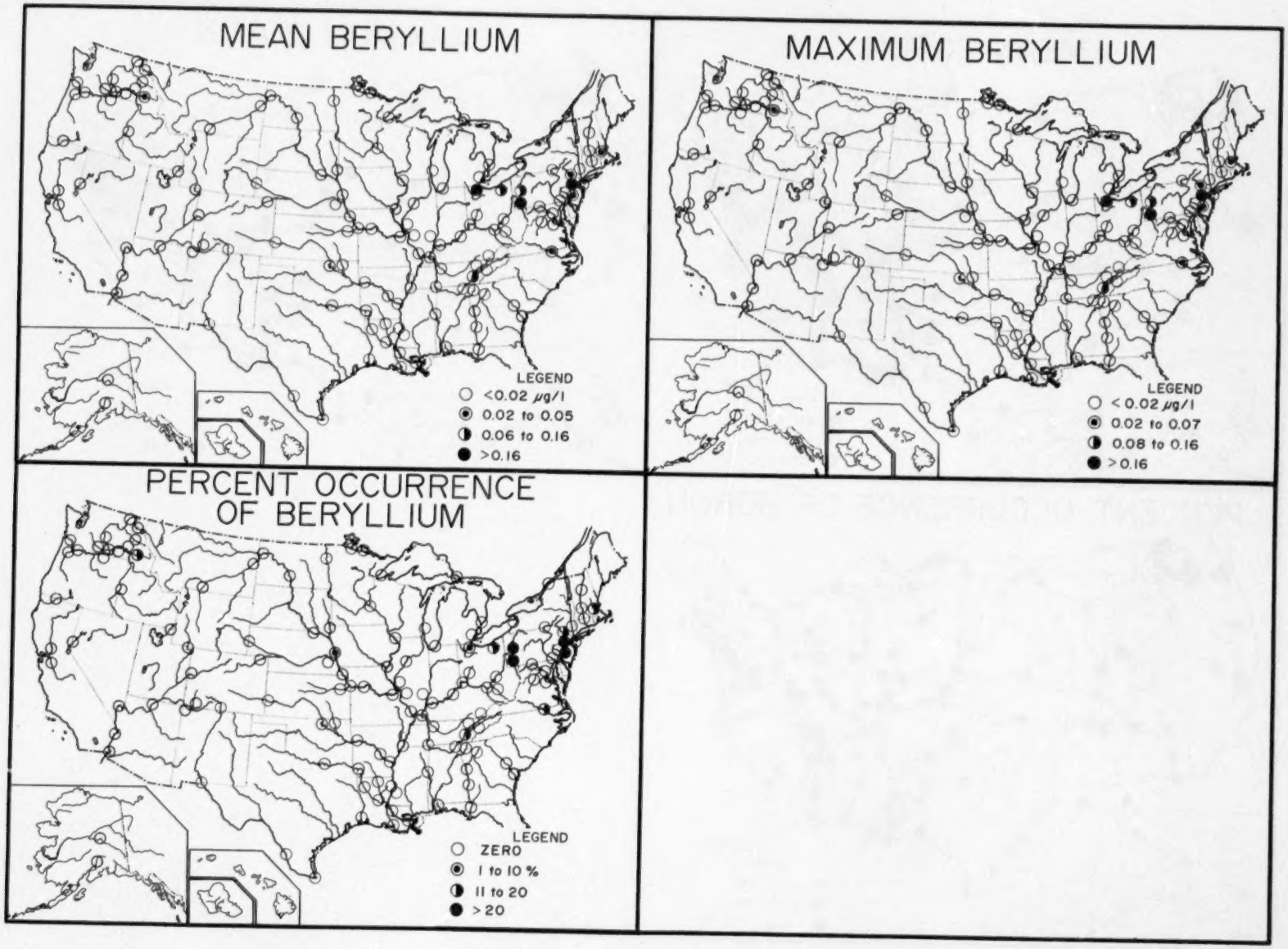


Figure 15. BERYLLIUM

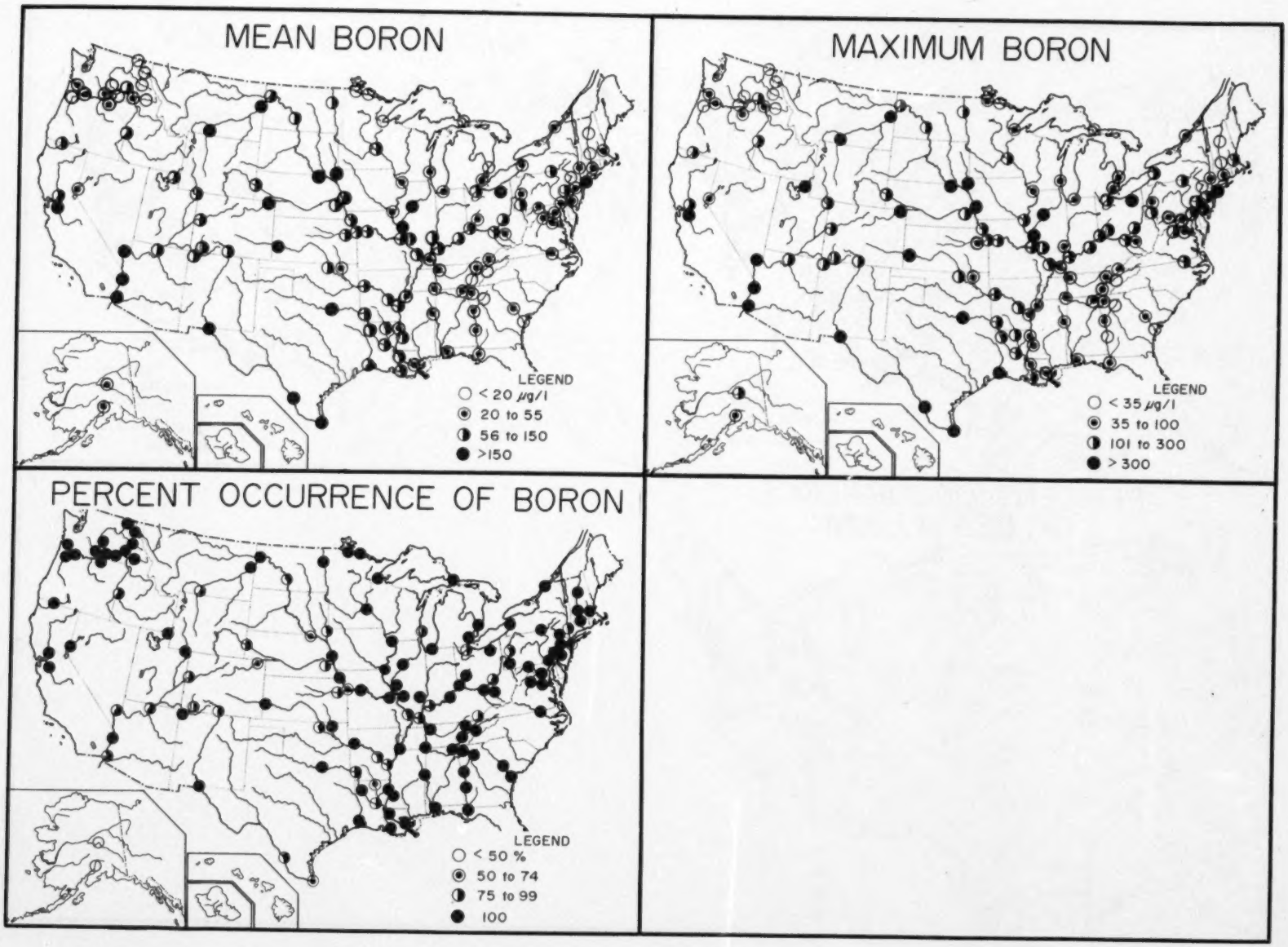


Figure 16. BORON

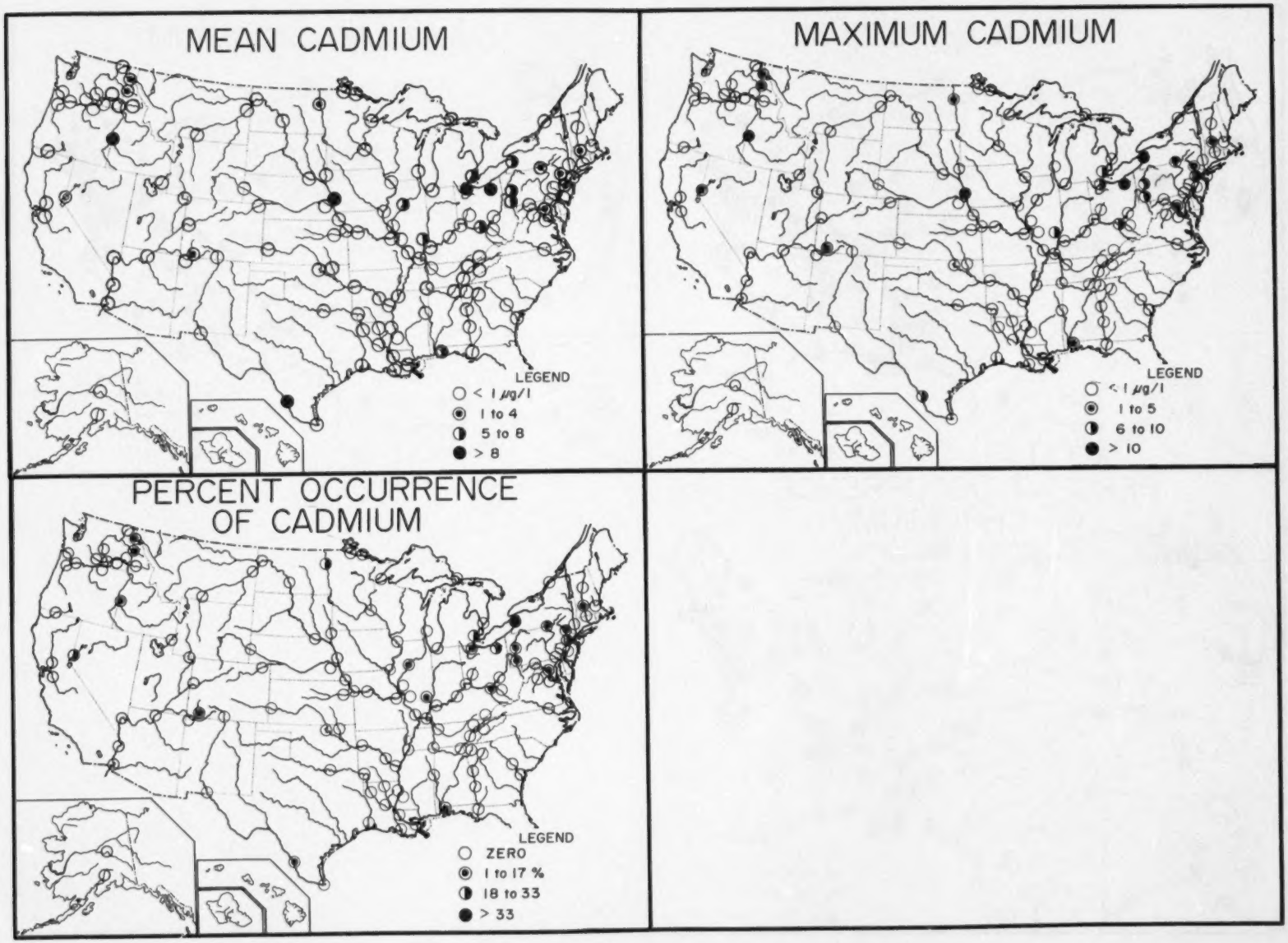


Figure 17. CADMIUM

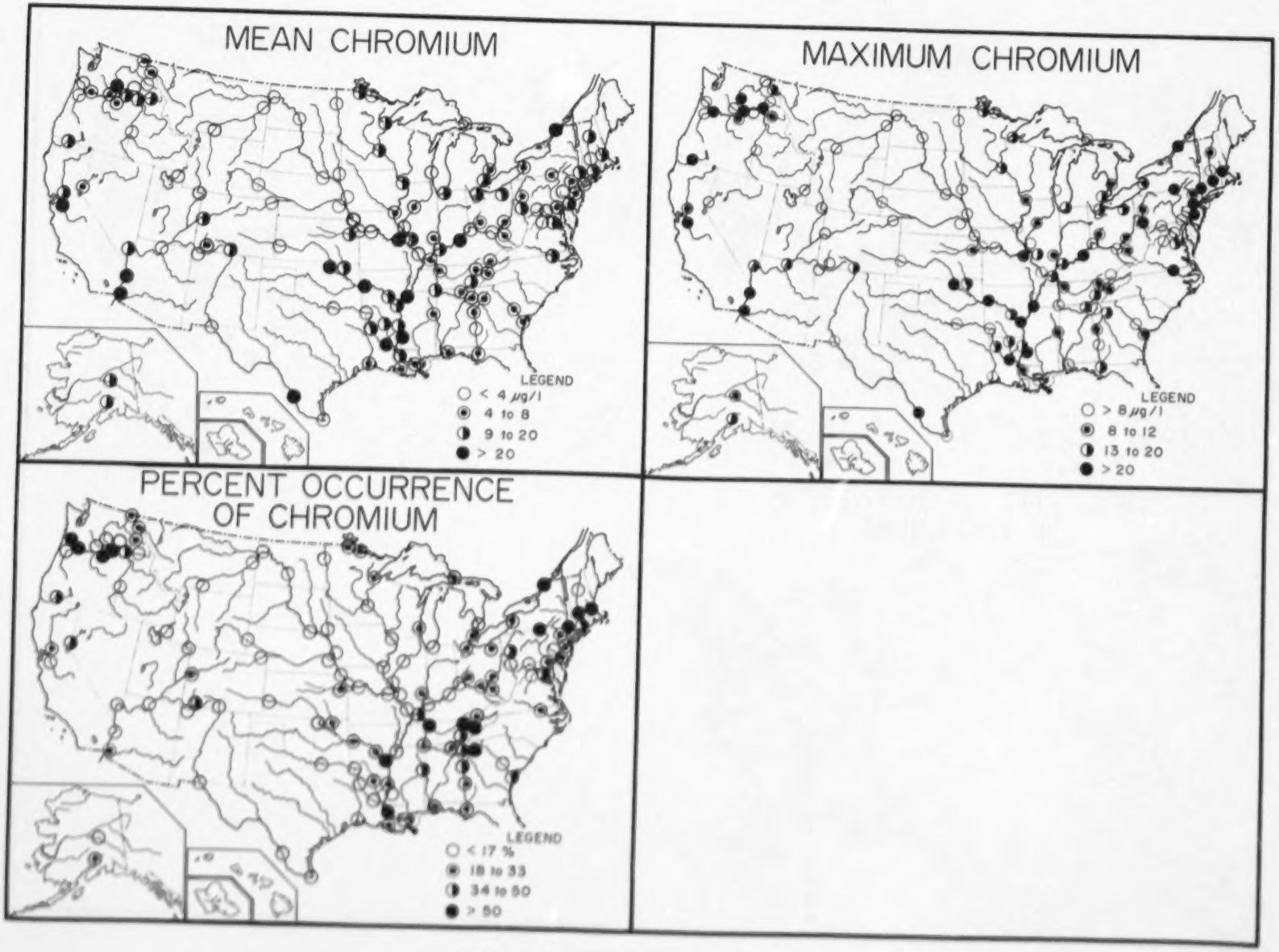


Figure 18. CHROMIUM

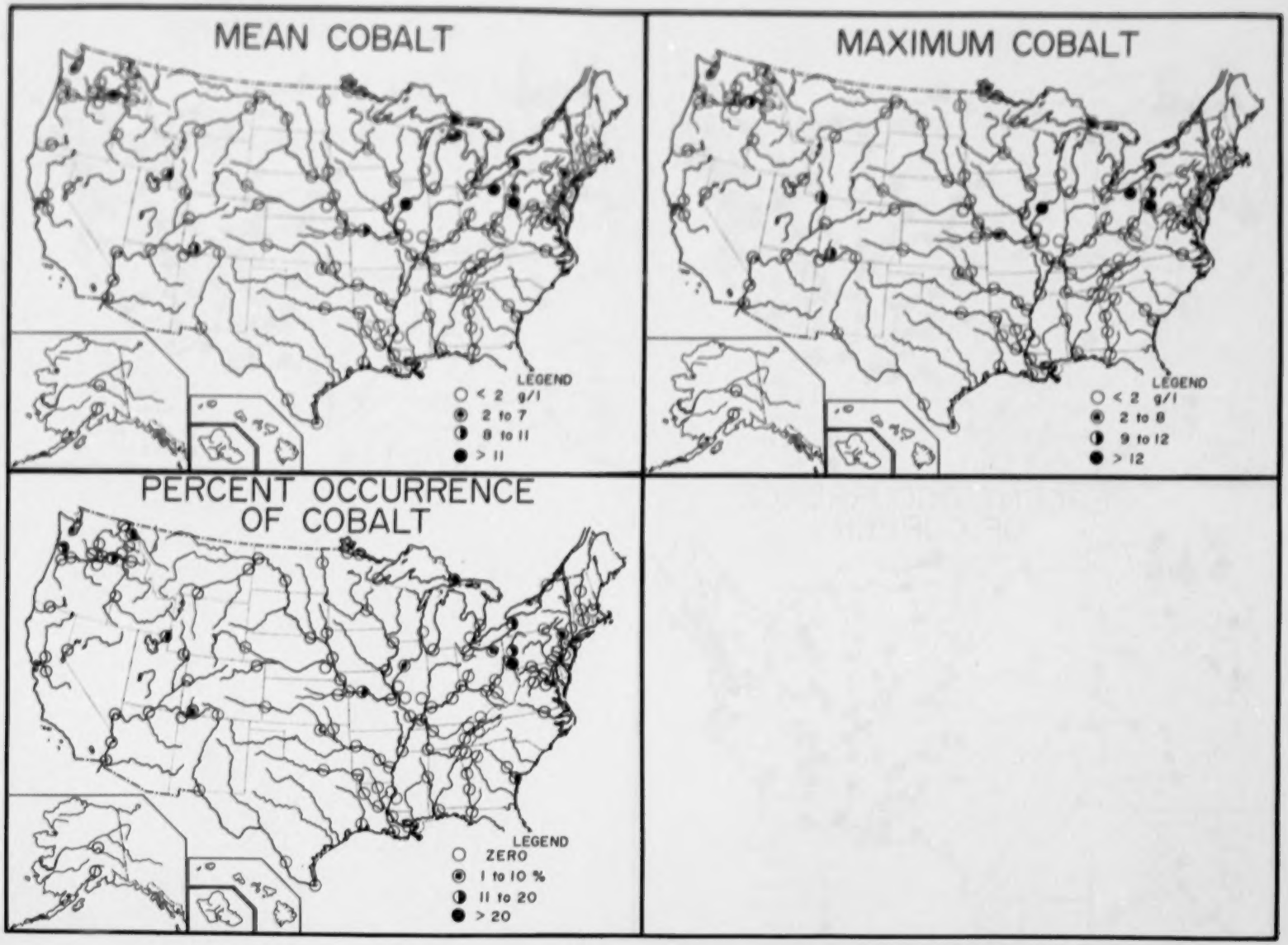


Figure 19. COBALT

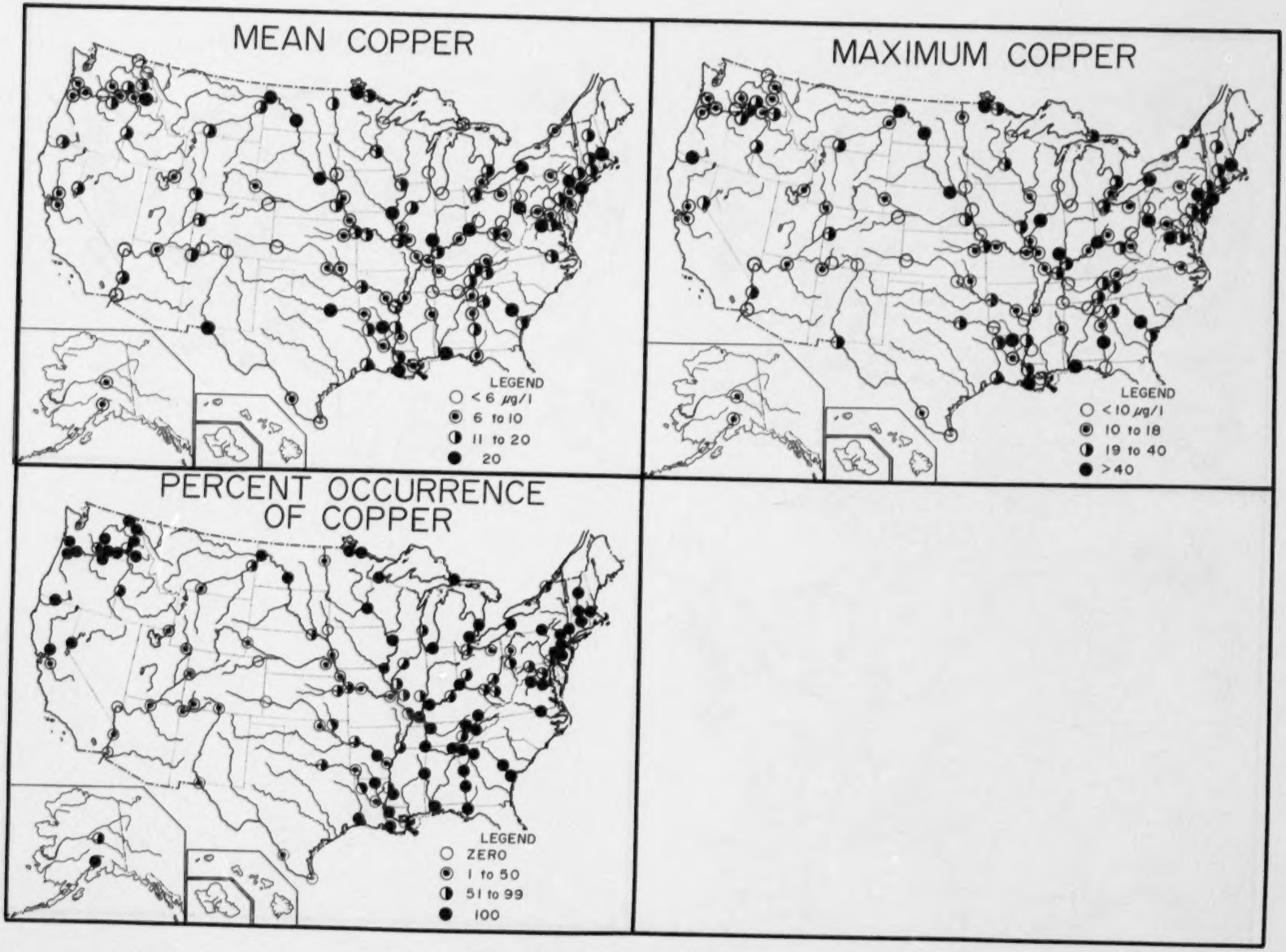


Figure 20. COPPER

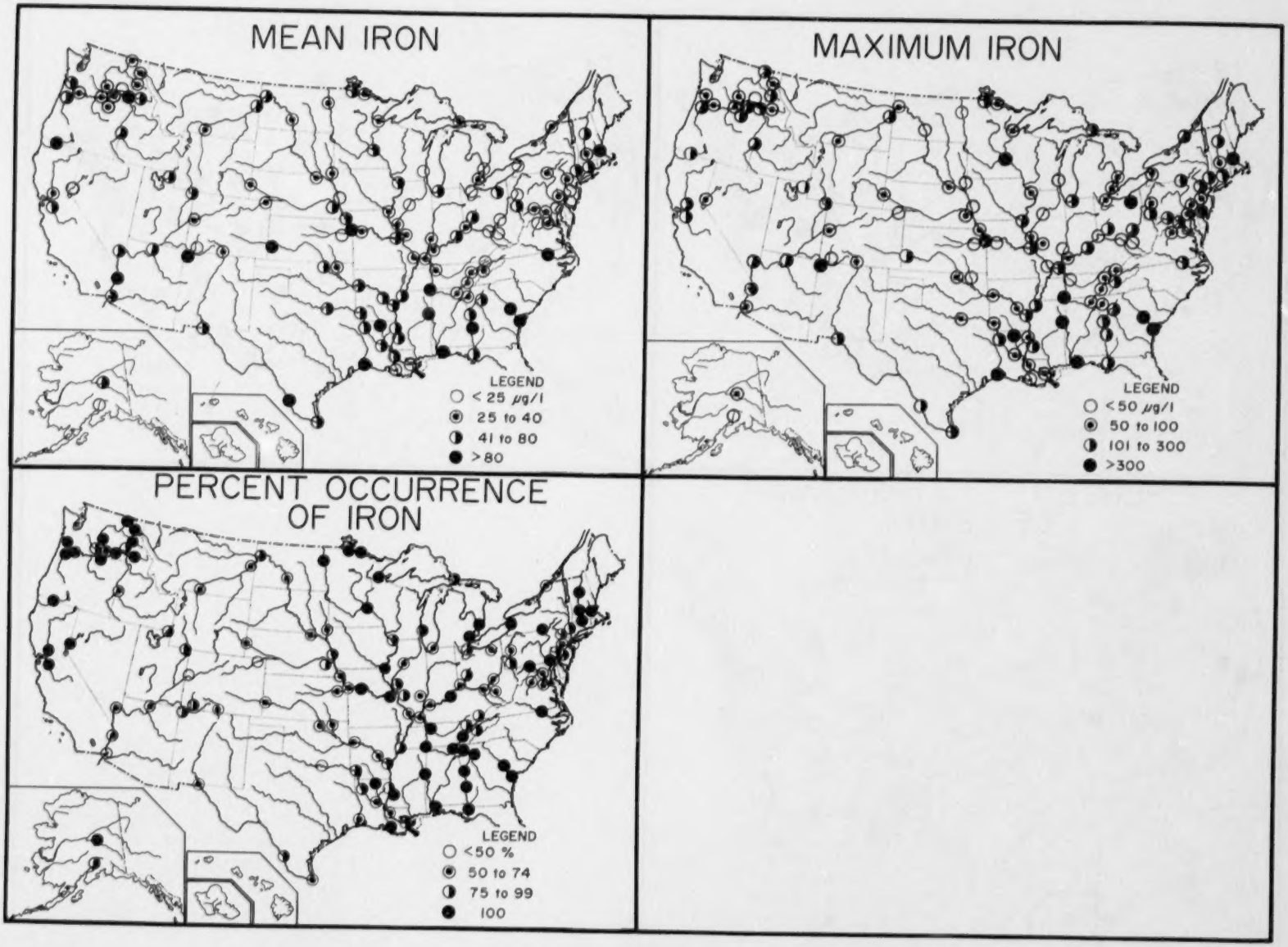


Figure 21. IRON

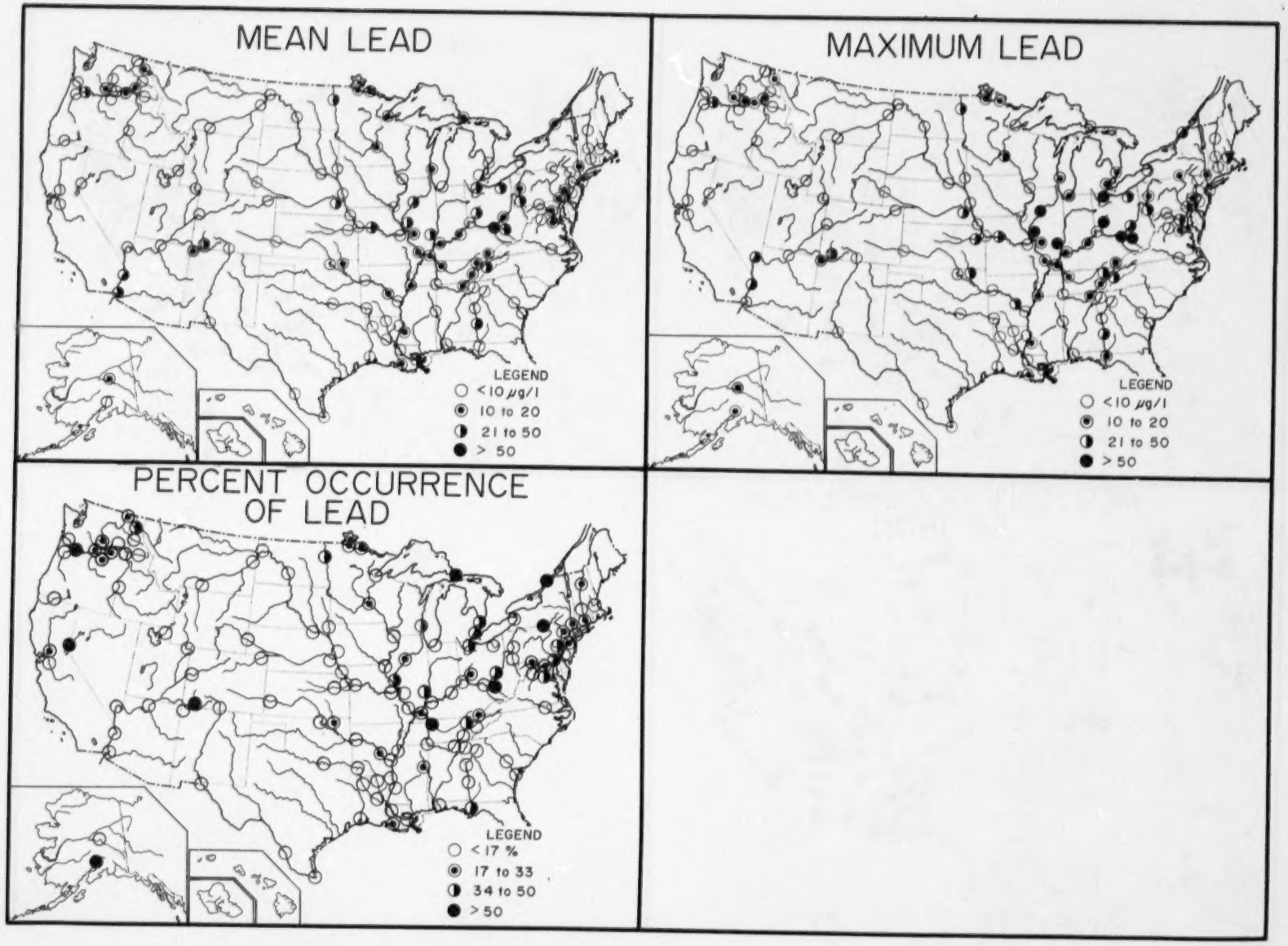


Figure 22. LEAD

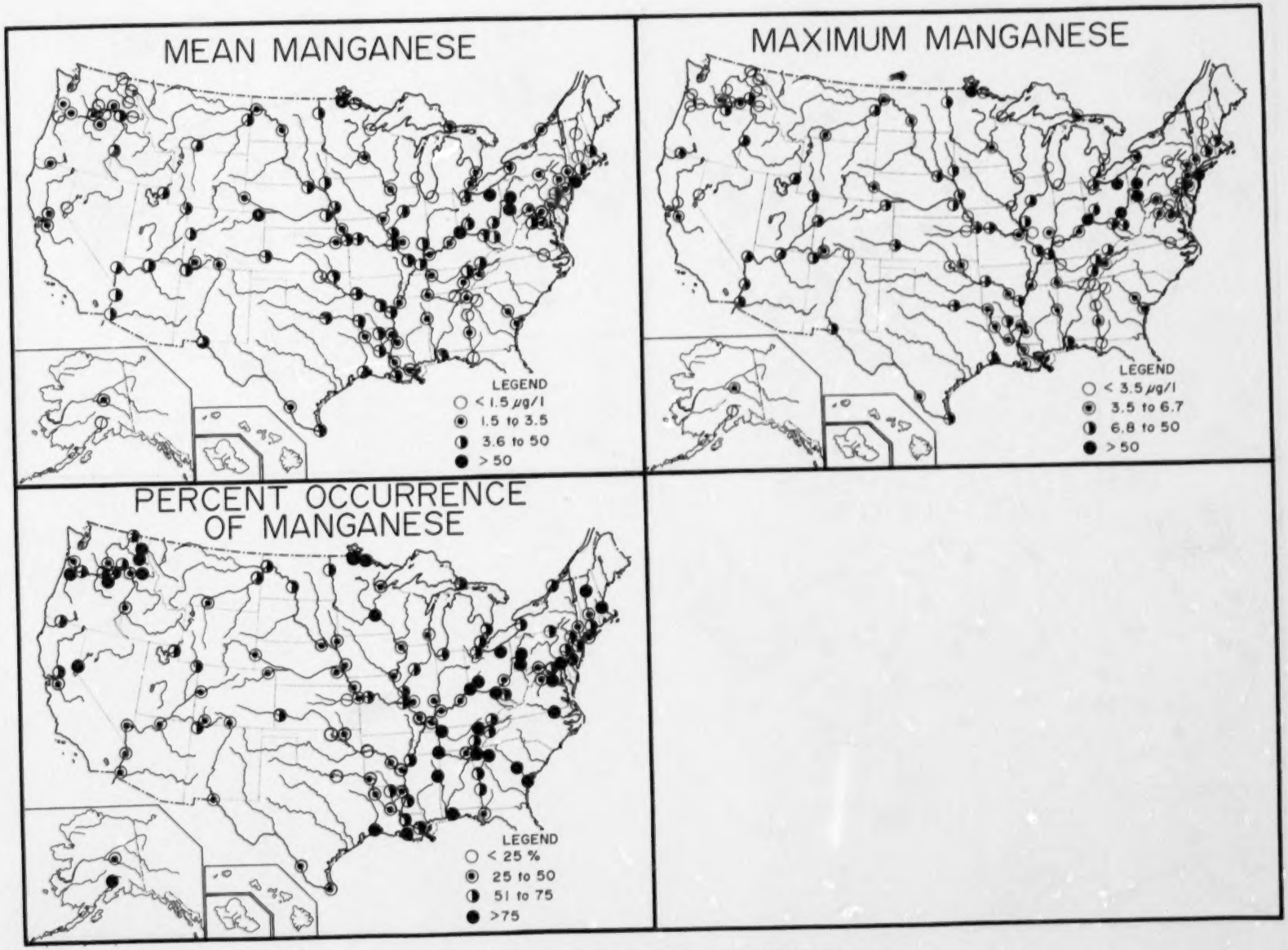


Figure 23. MANGANESE

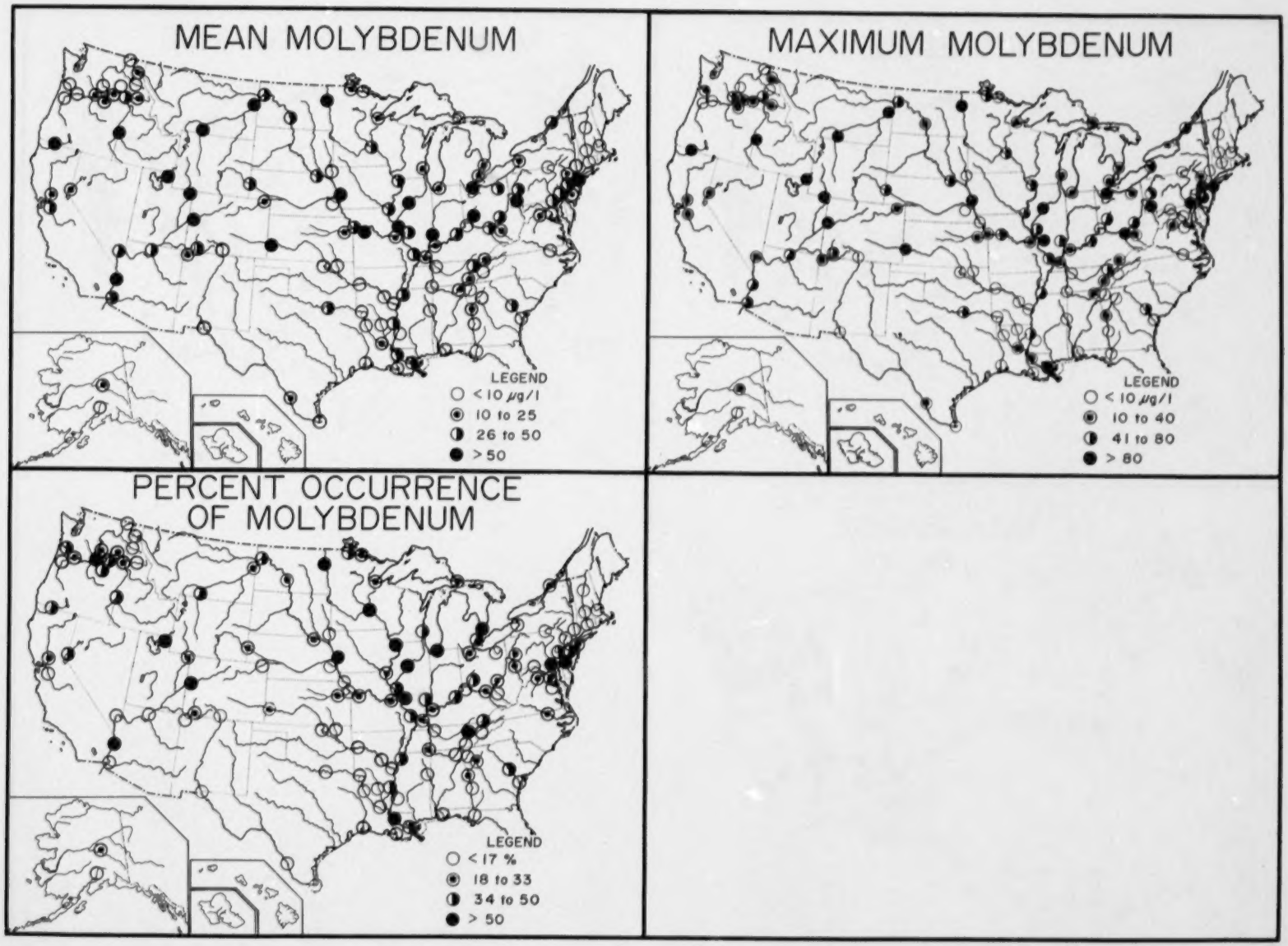


Figure 24. MOLYBDENUM

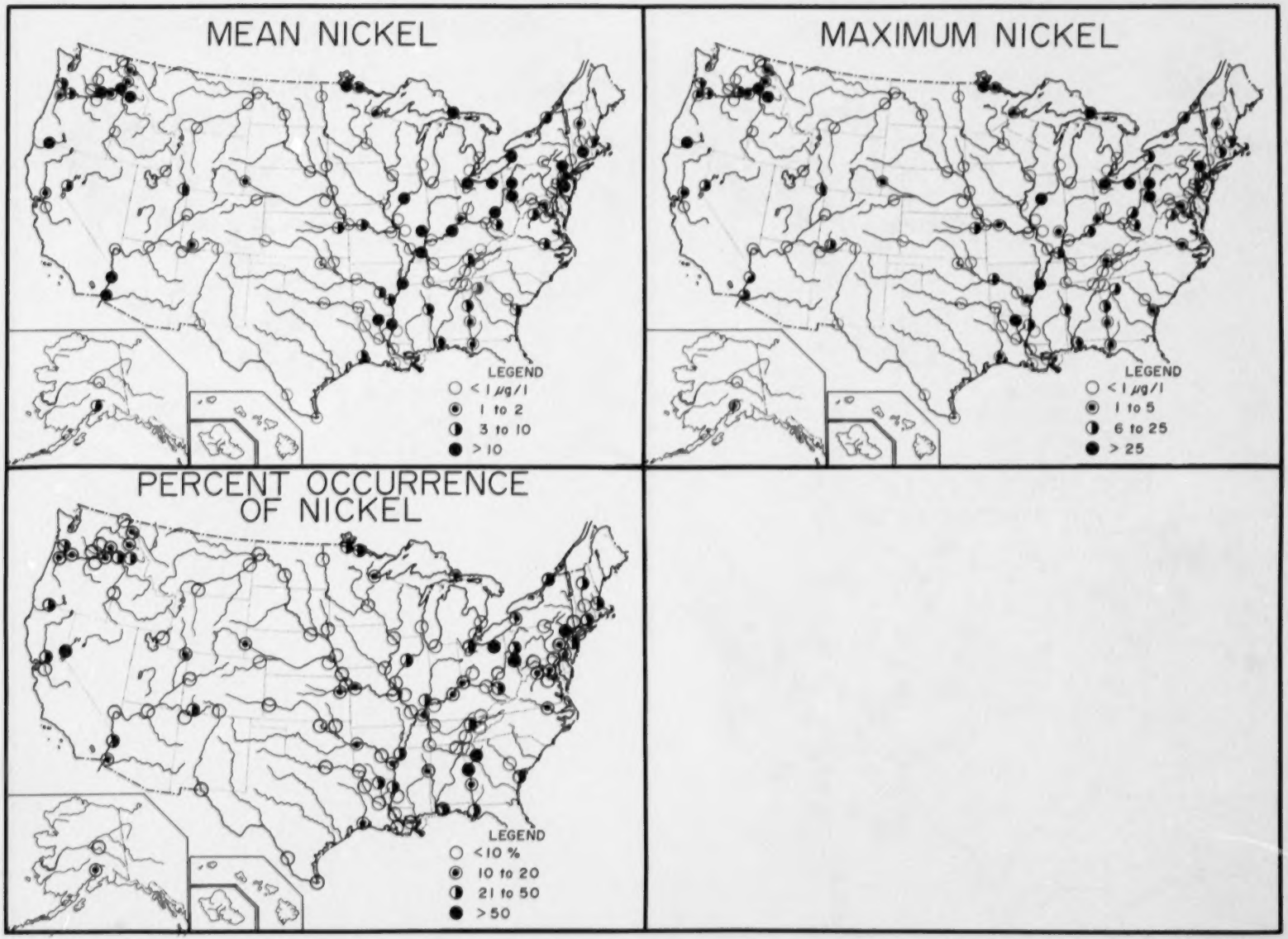


Figure 25. NICKEL

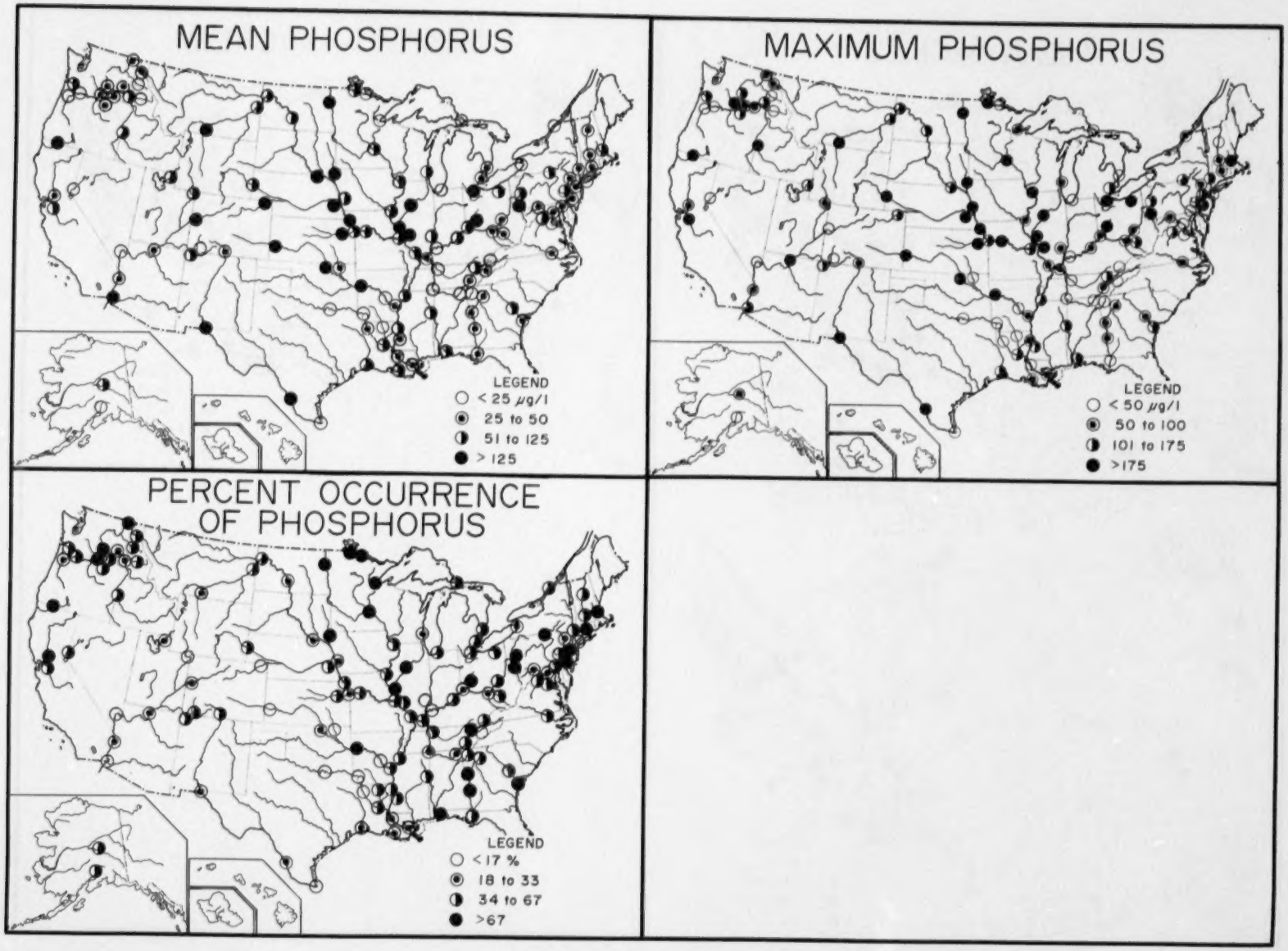


Figure 26. PHOSPHORUS

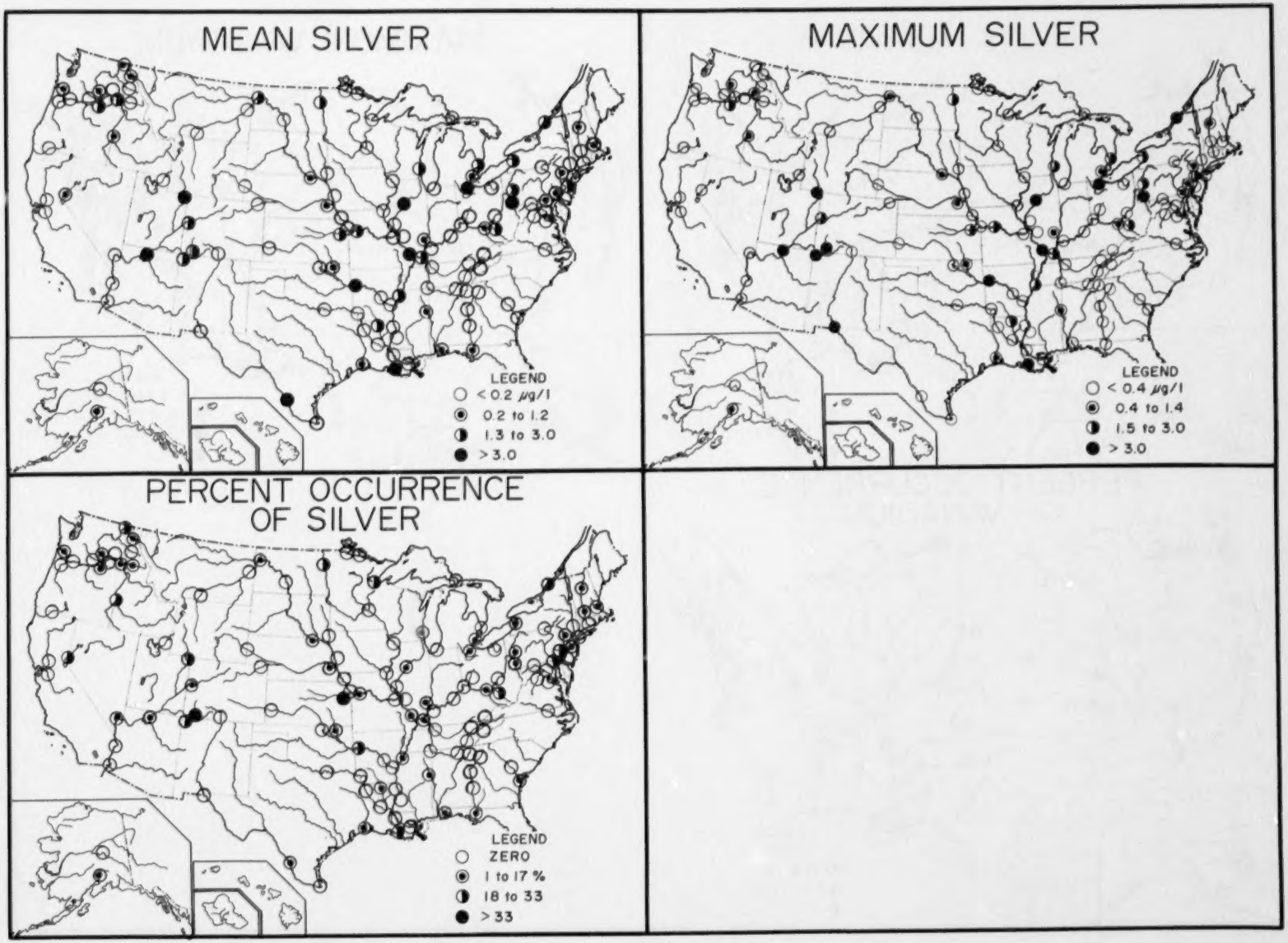


Figure 27. SILVER

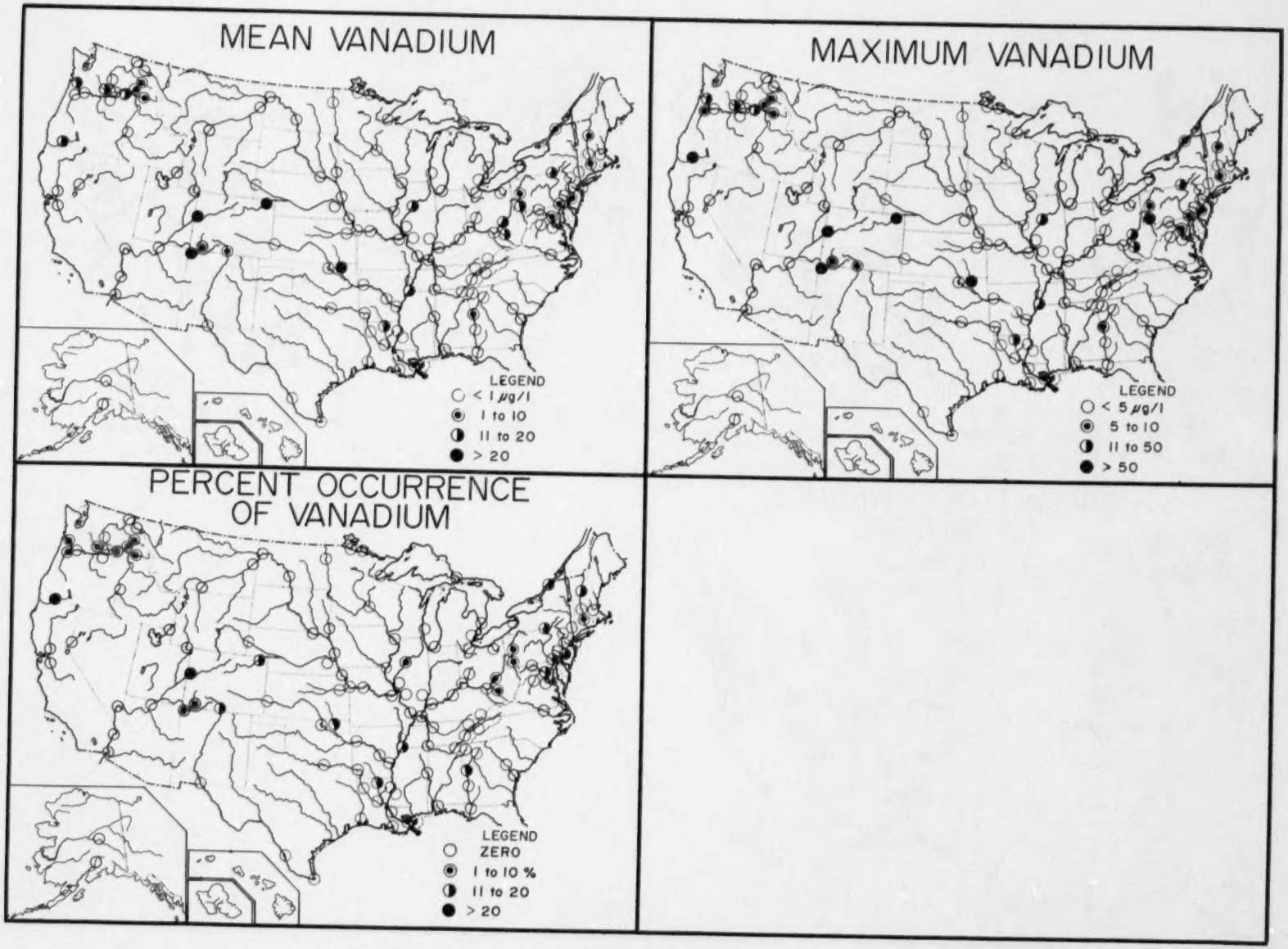


Figure 28. VANADIUM

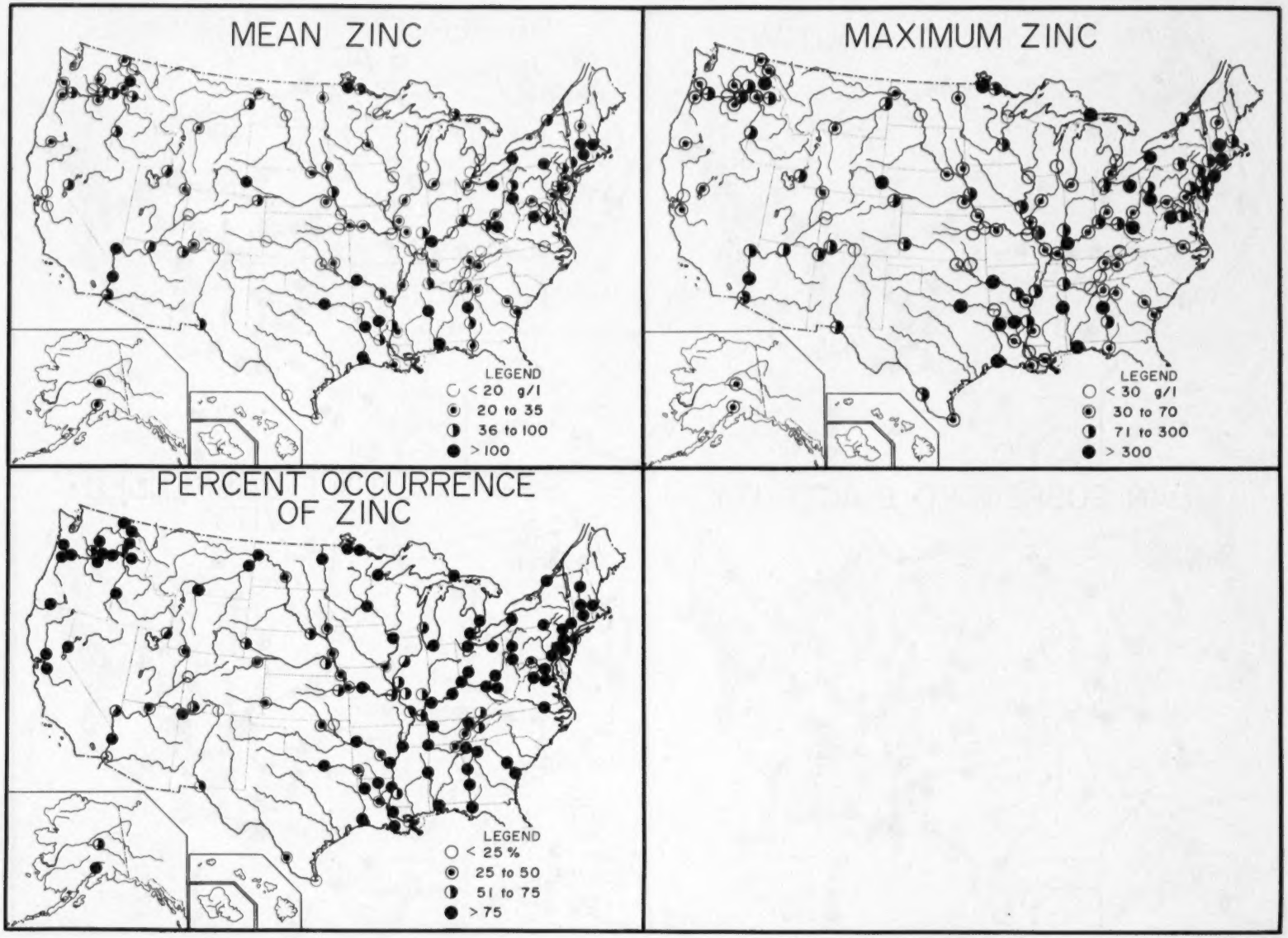


Figure 29. ZINC

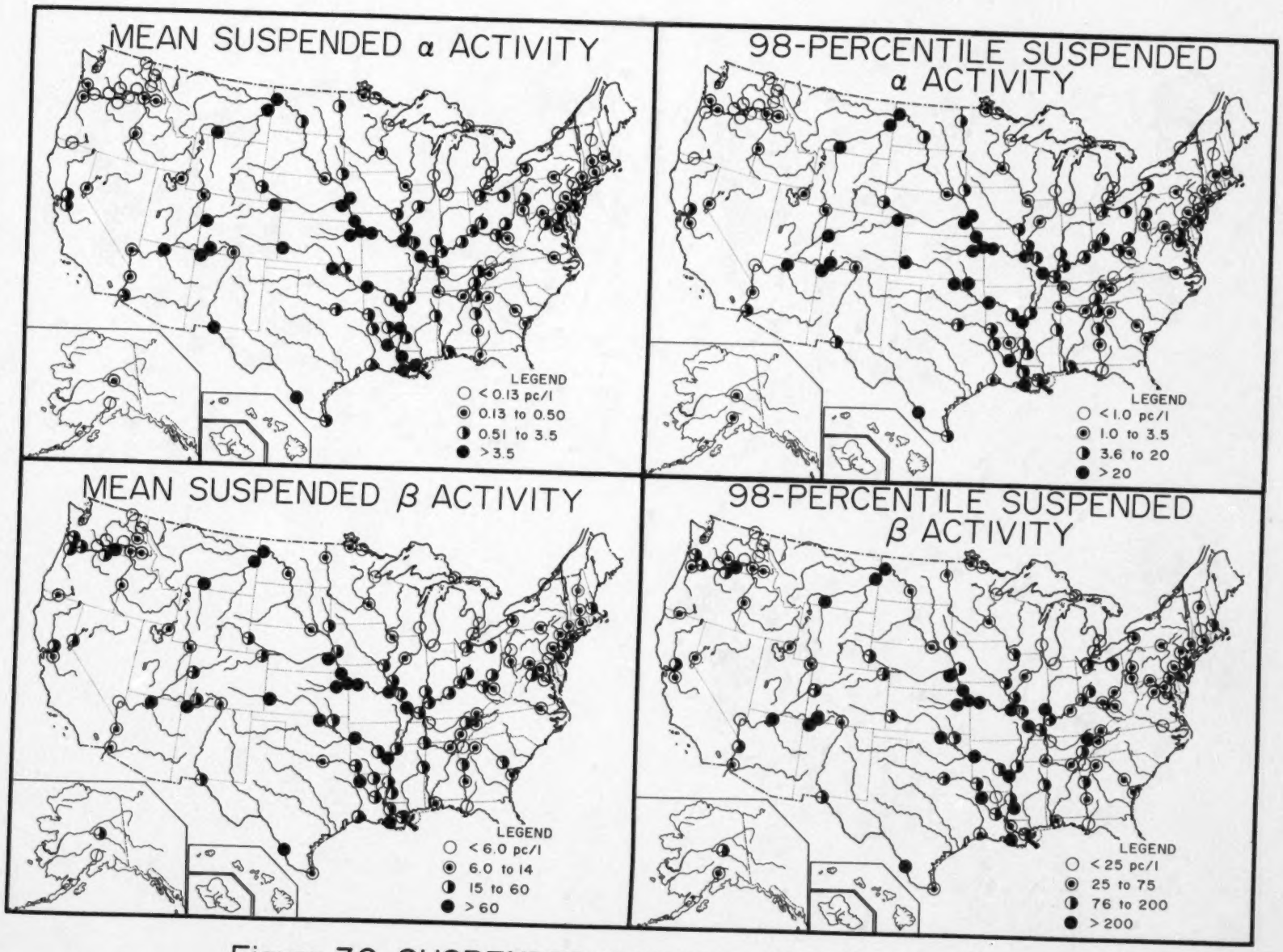


Figure 30. SUSPENDED GROSS α AND β ACTIVITY

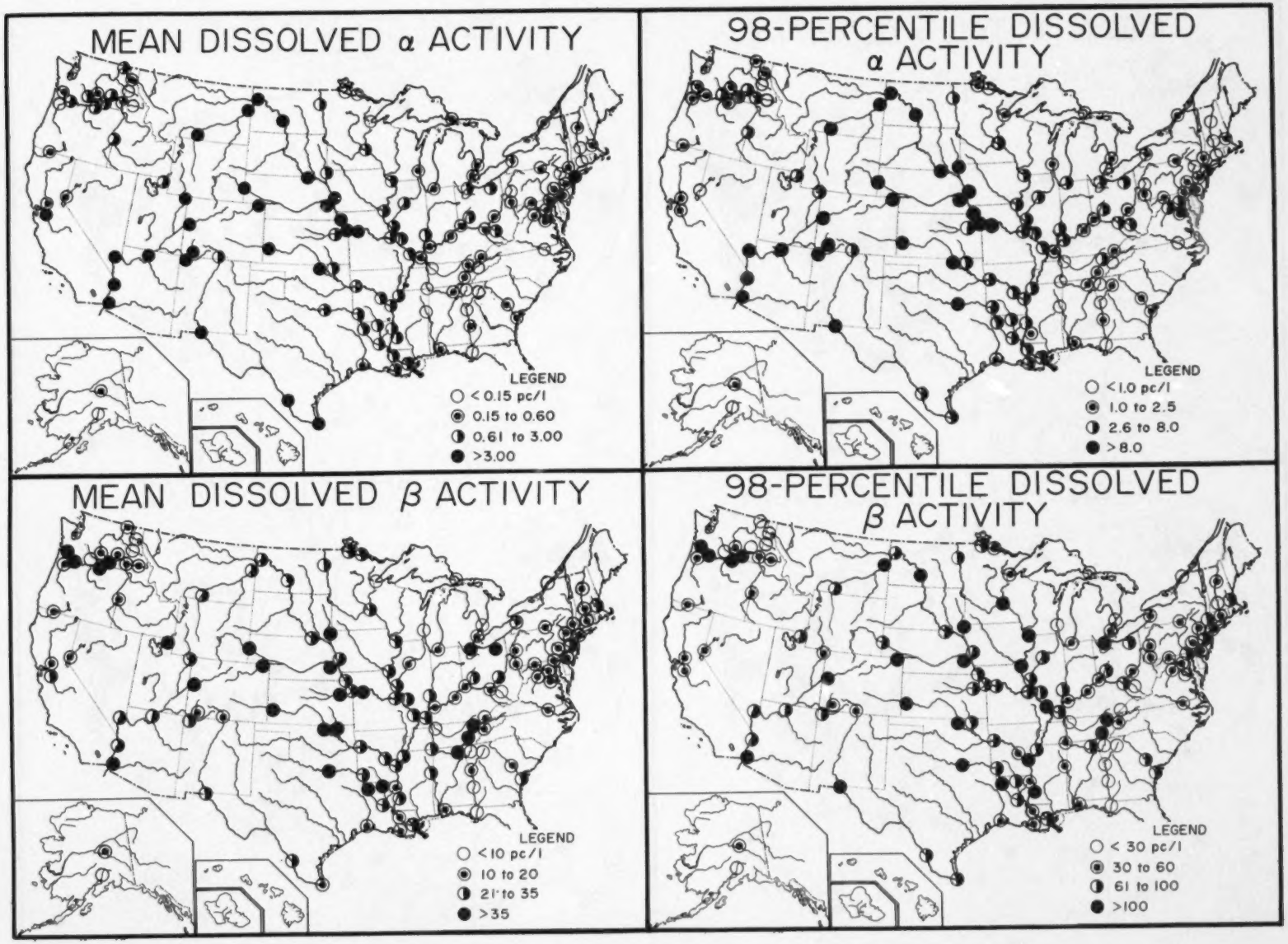


Figure 31. DISSOLVED GROSS α AND β ACTIVITY

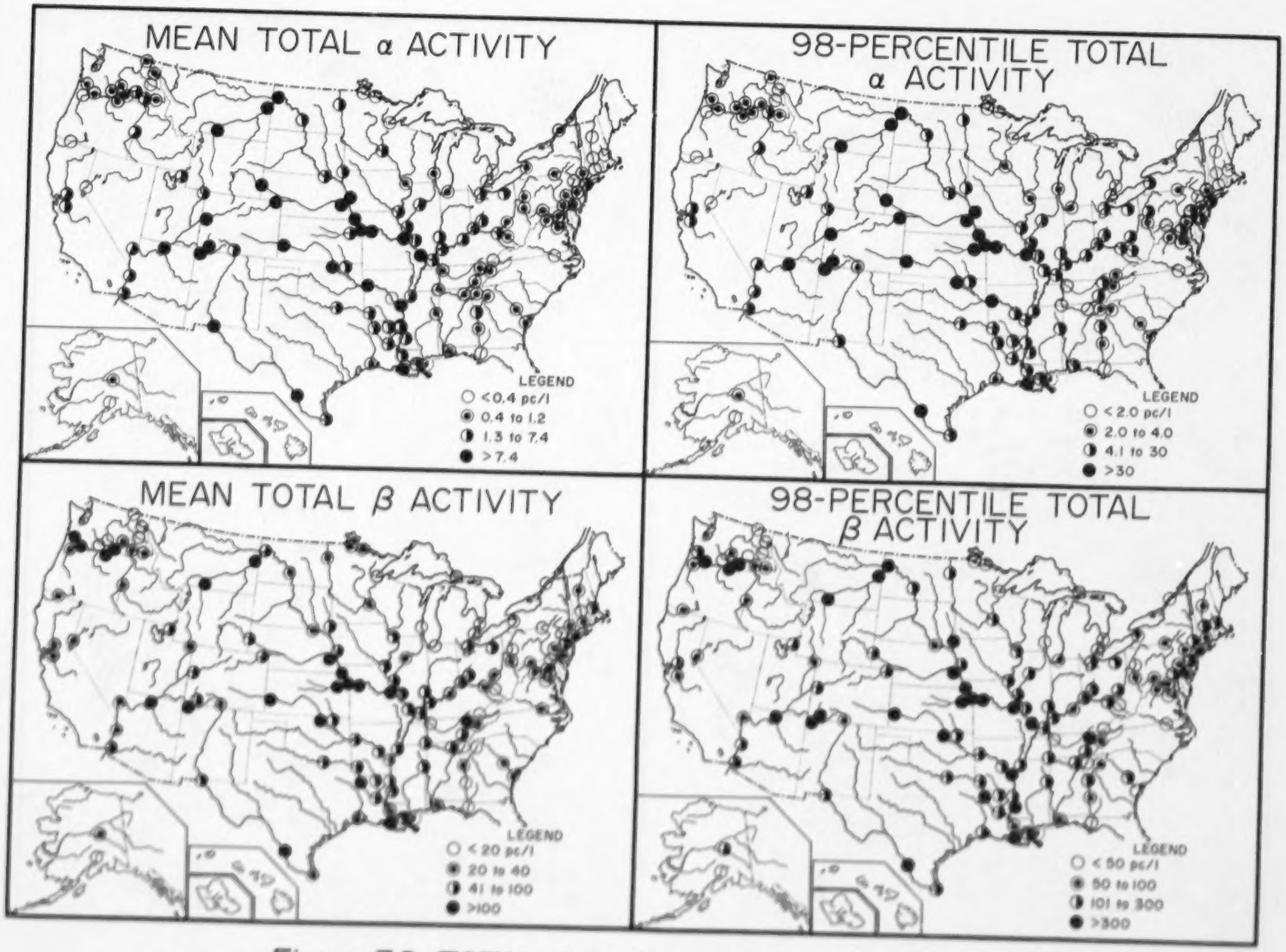


Figure 32. TOTAL GROSS α AND β ACTIVITY

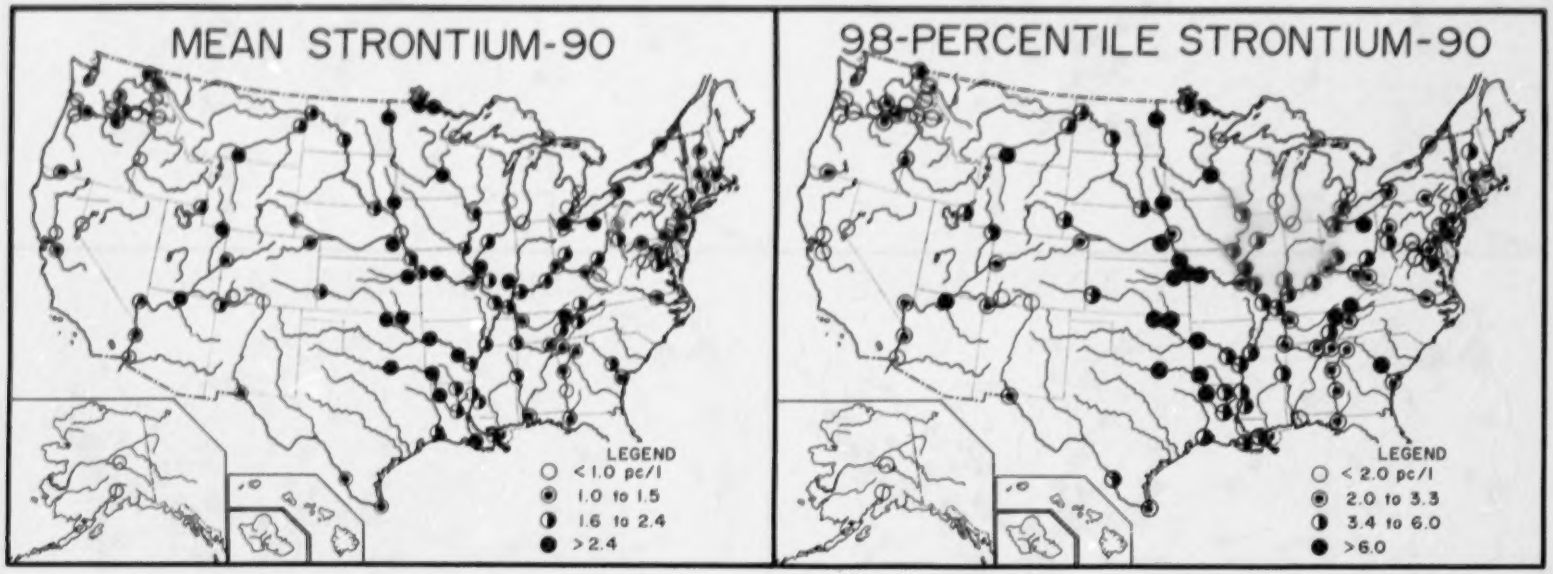


Figure 33. STRONTIUM-90.

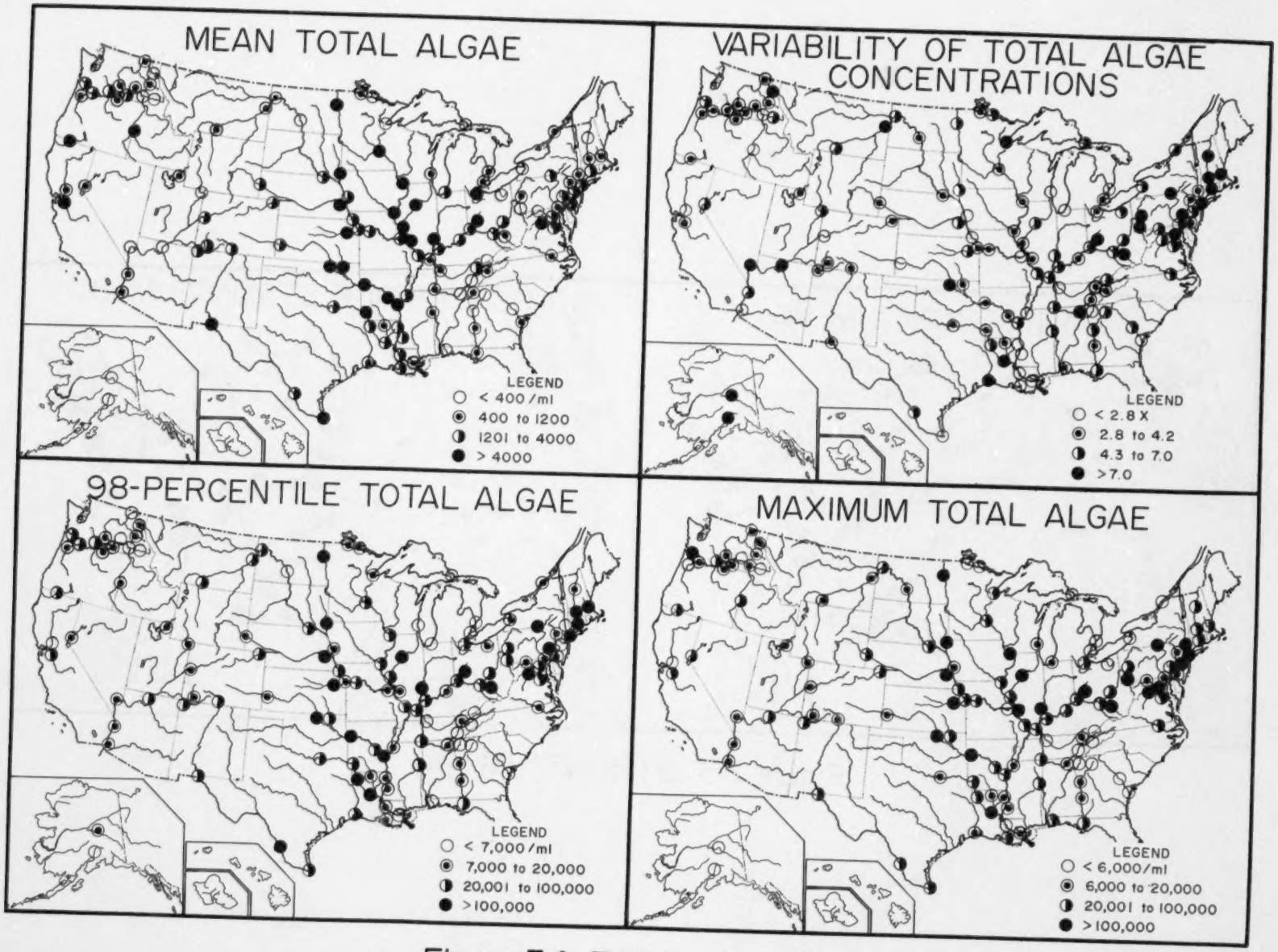


Figure 34. TOTAL ALGAE.

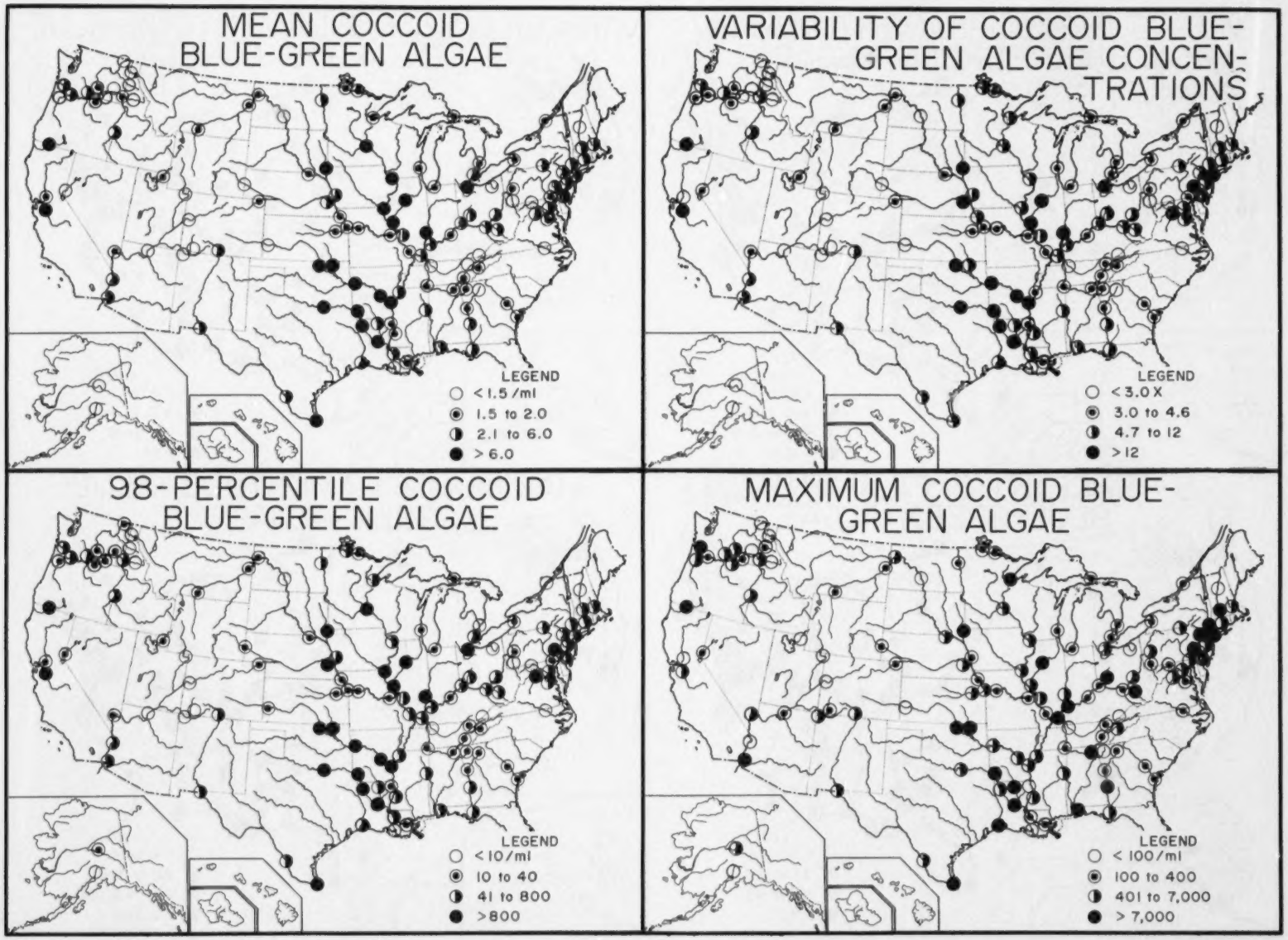


Figure 35. COCCOID BLUE-GREEN ALGAE.

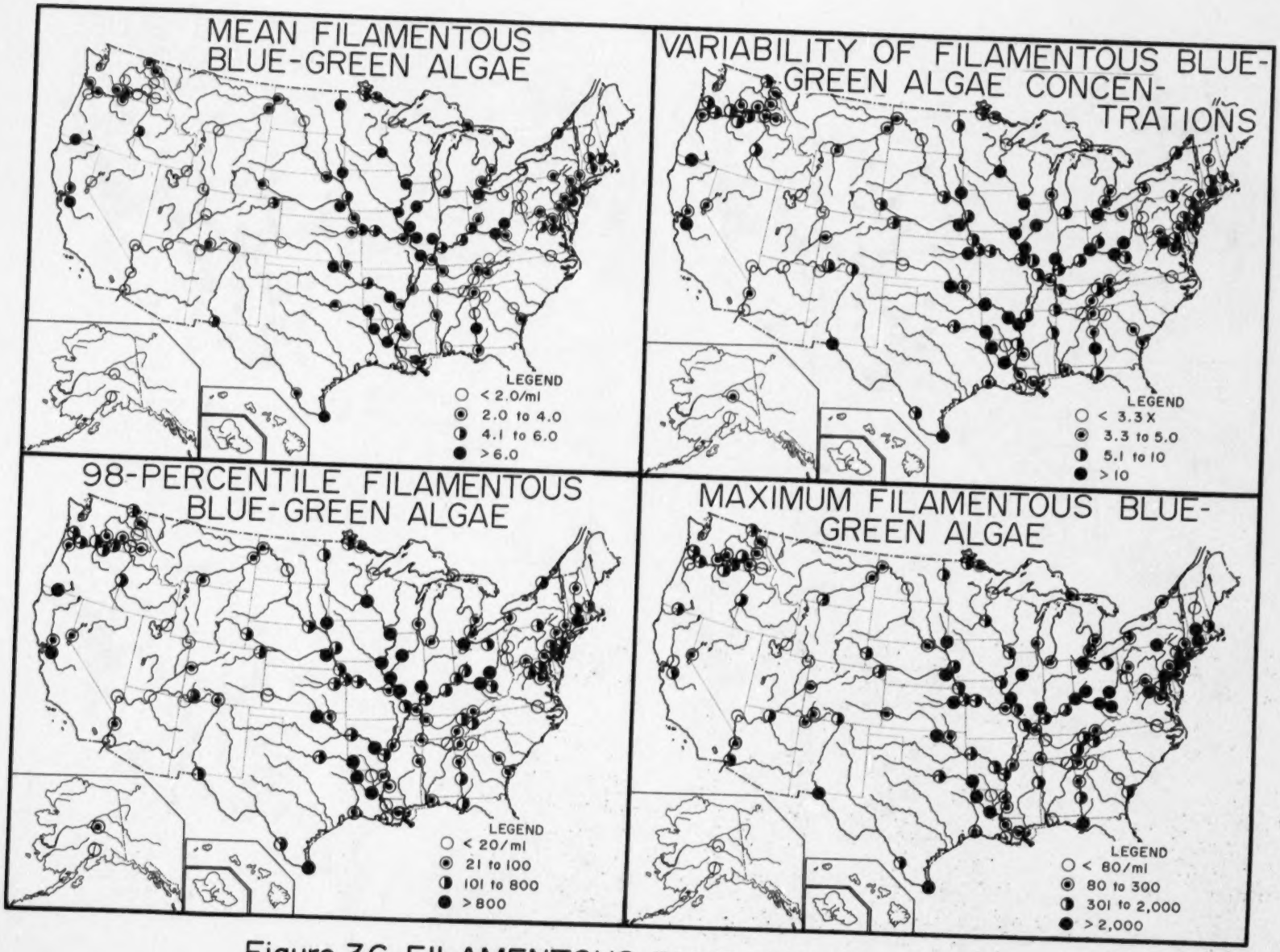


Figure 36. FILAMENTOUS BLUE-GREEN ALGAE.

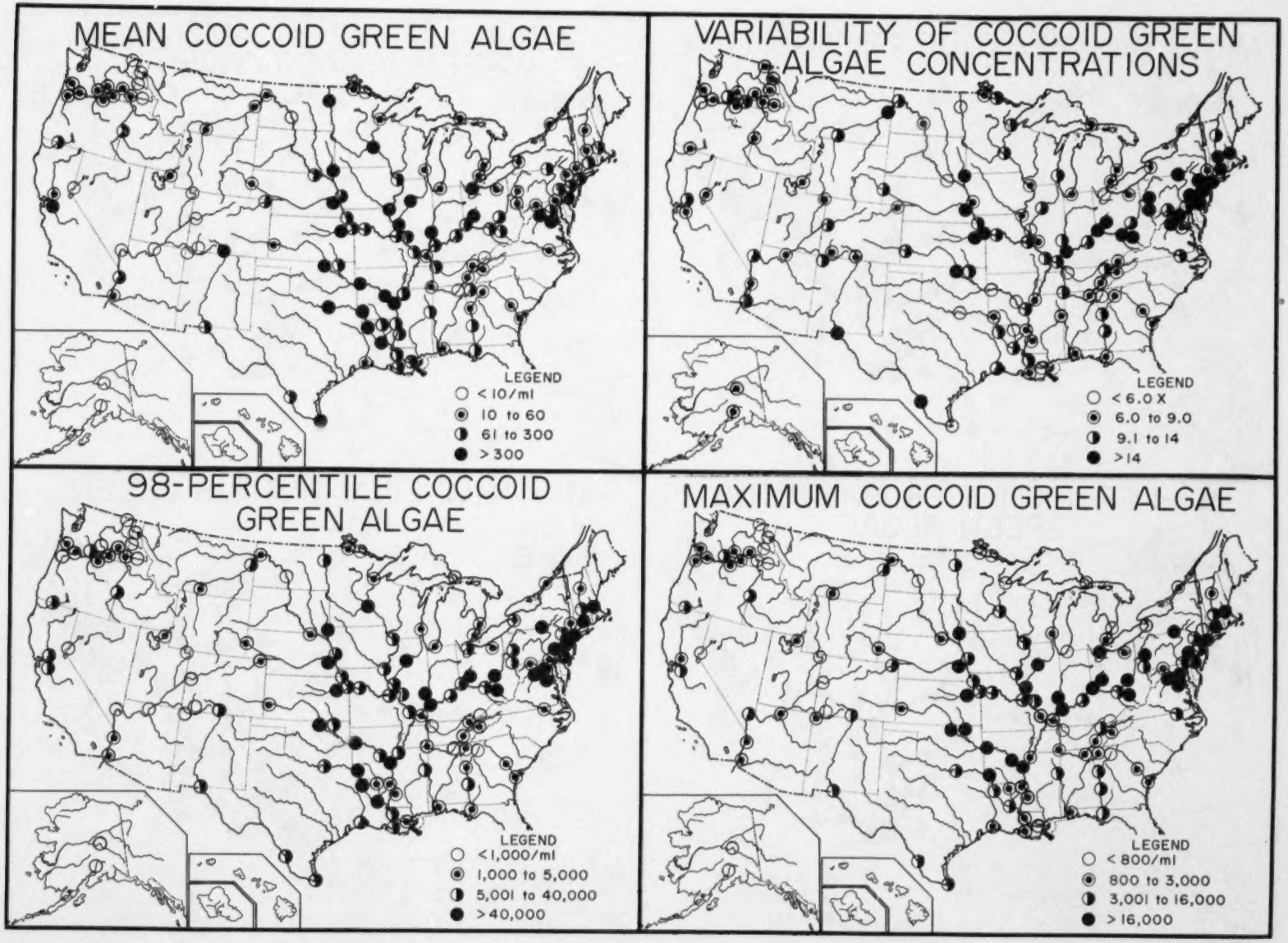


Figure 37. COCCOID GREEN ALGAE.

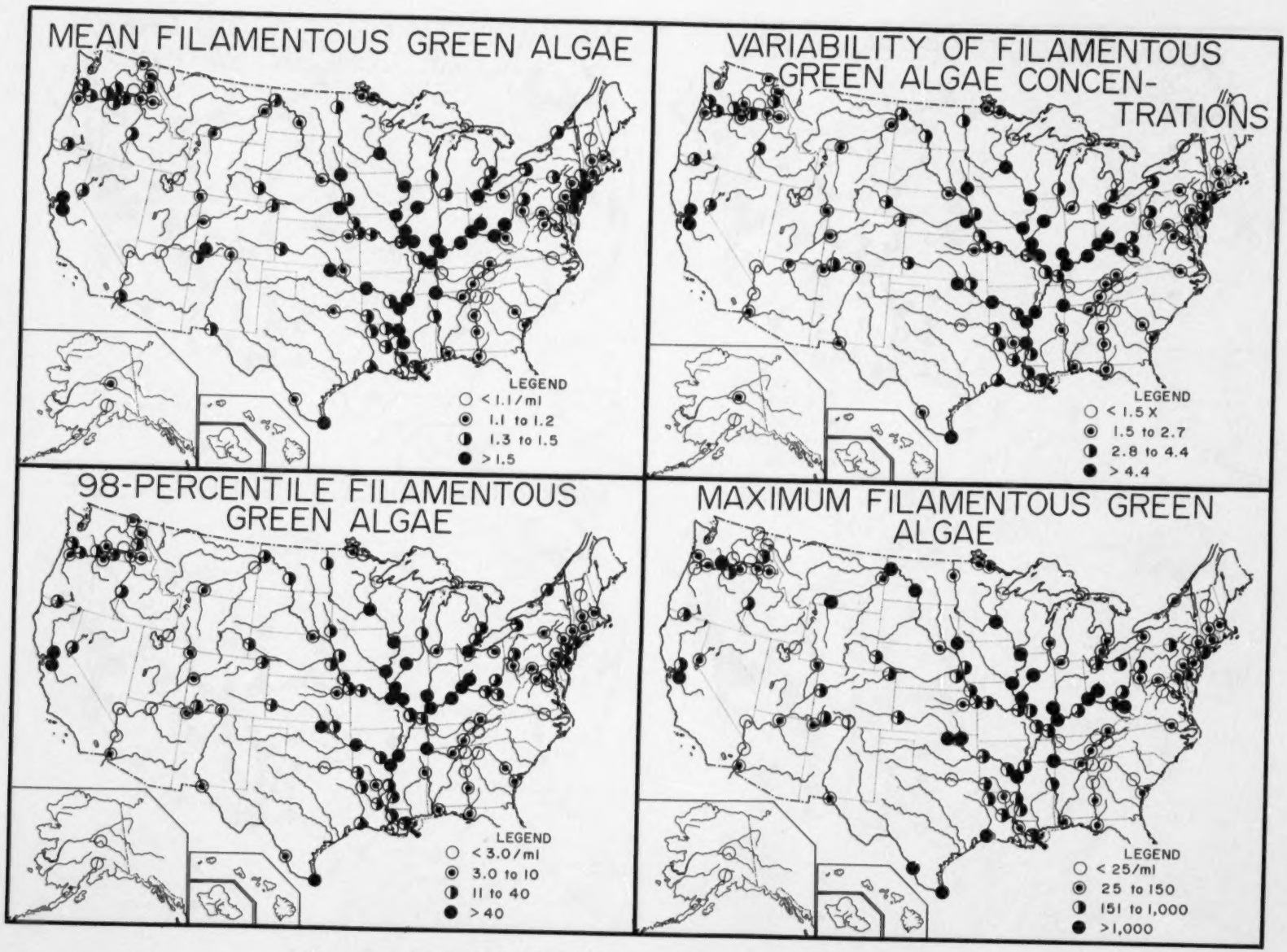


Figure 38. FILAMENTOUS GREEN ALGAE.

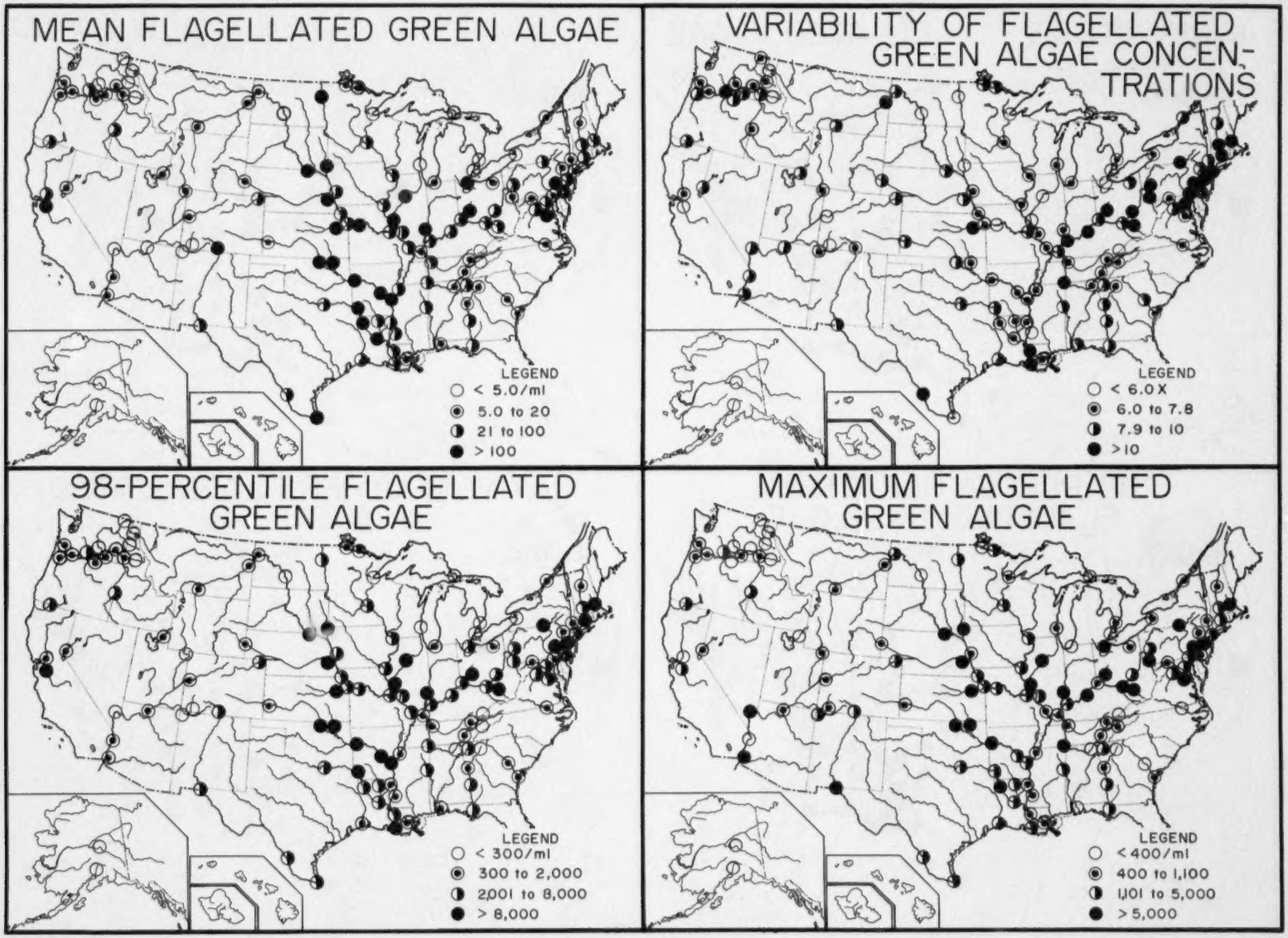


Figure 39. FLAGELLATED GREEN ALGAE.

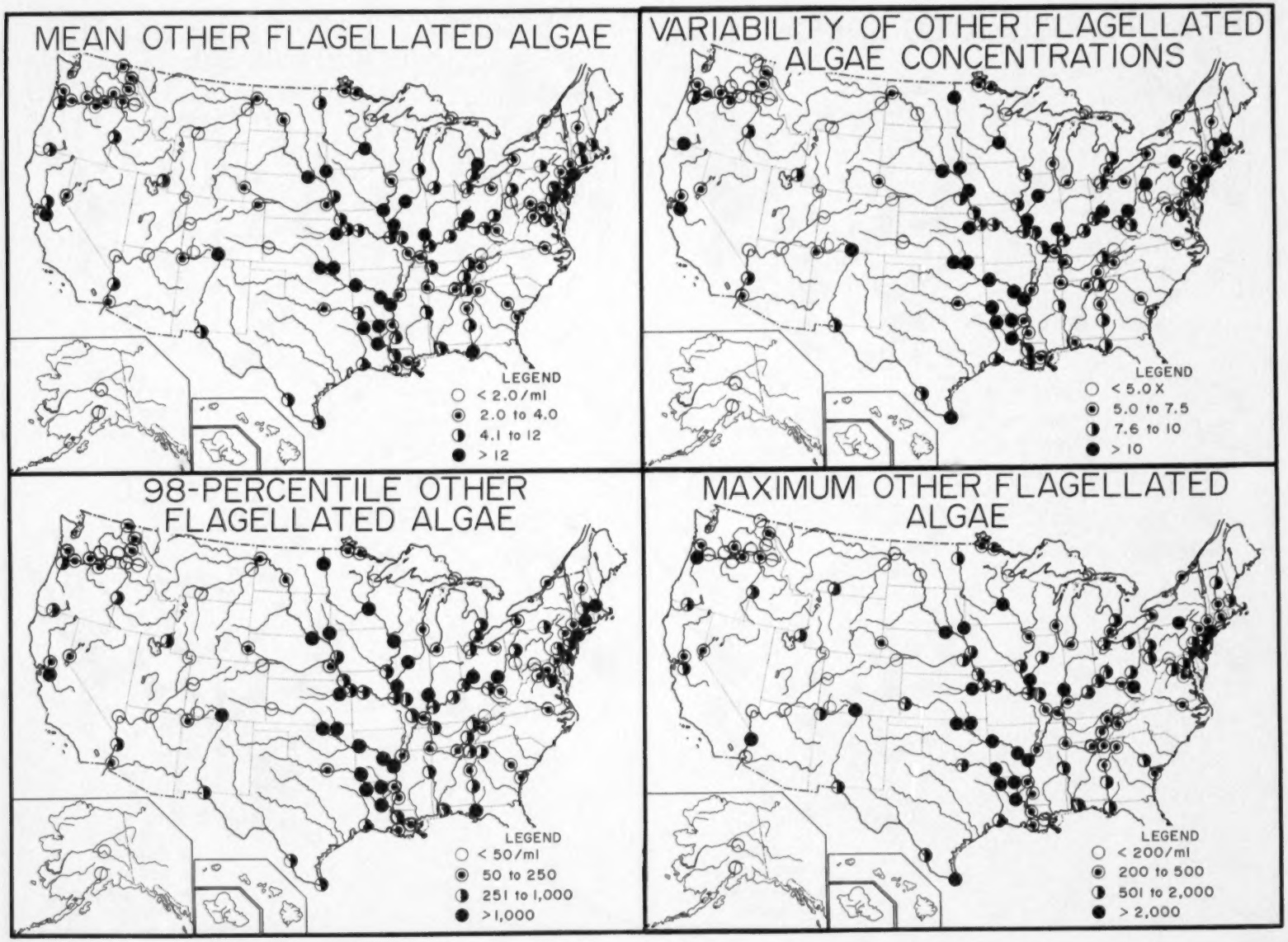


Figure 40. OTHER FLAGELLATED ALGAE.

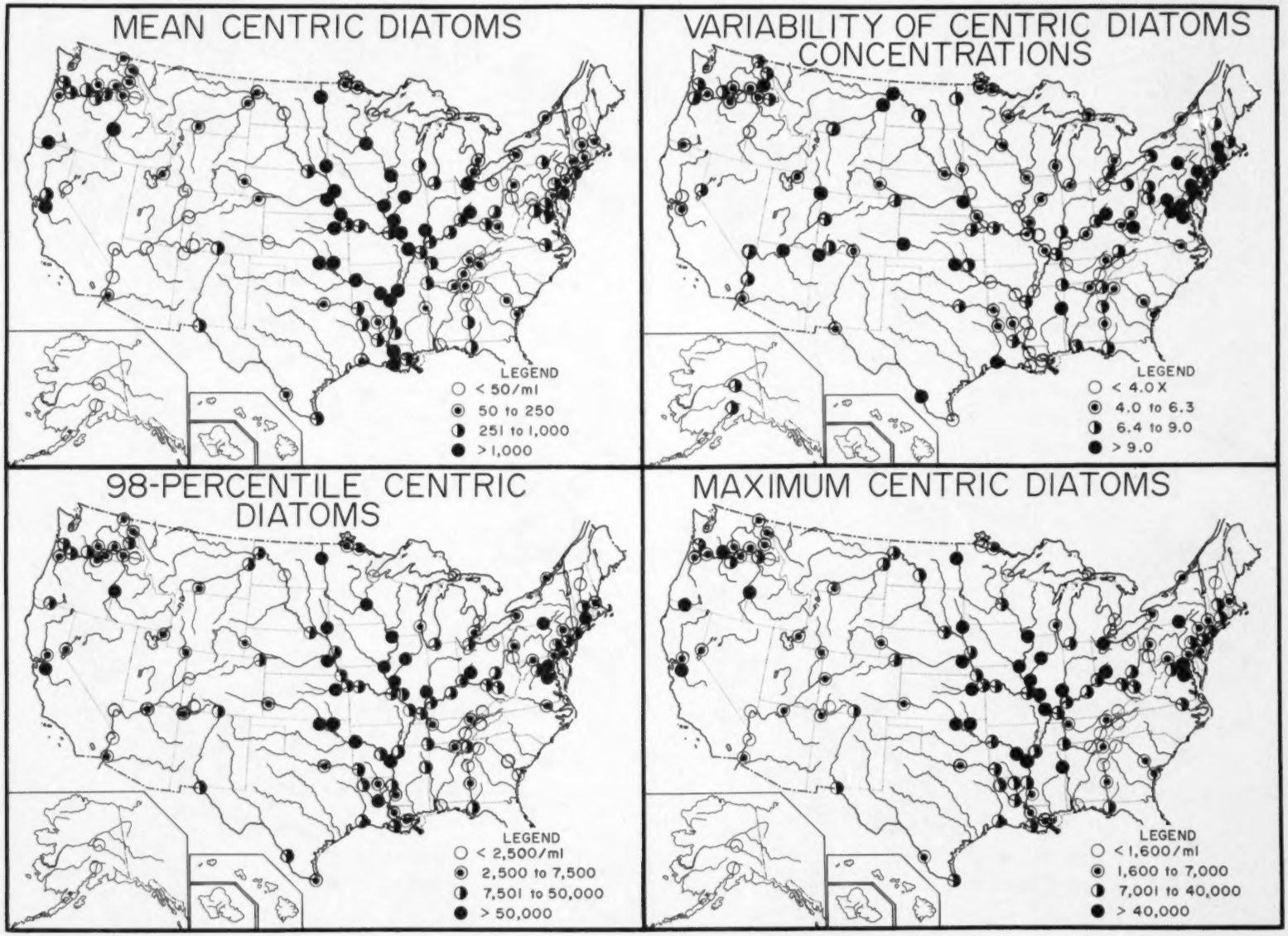


Figure 41. CENTRIC DIATOMS.

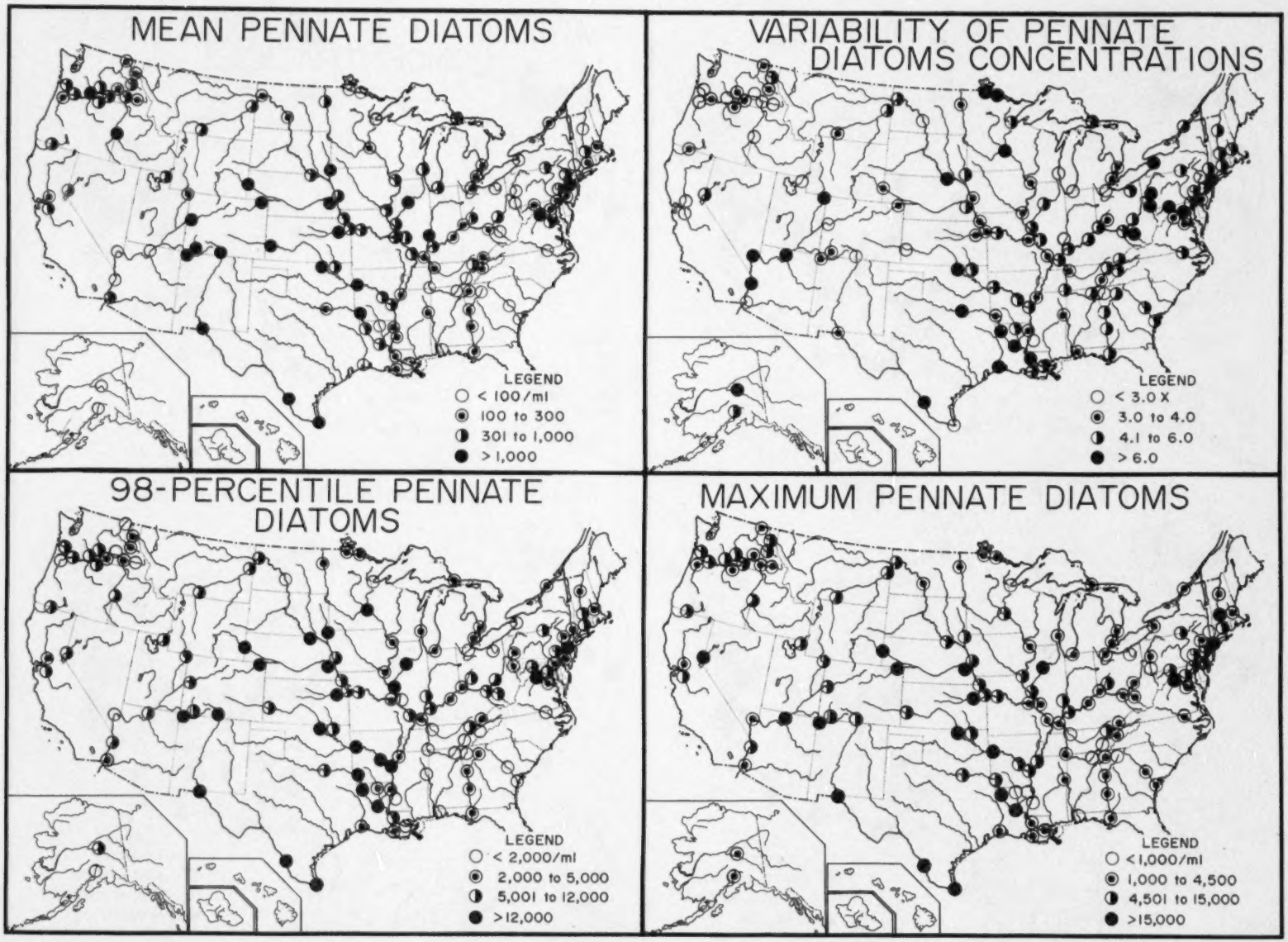


Figure 42. PENNATE DIATOMS.

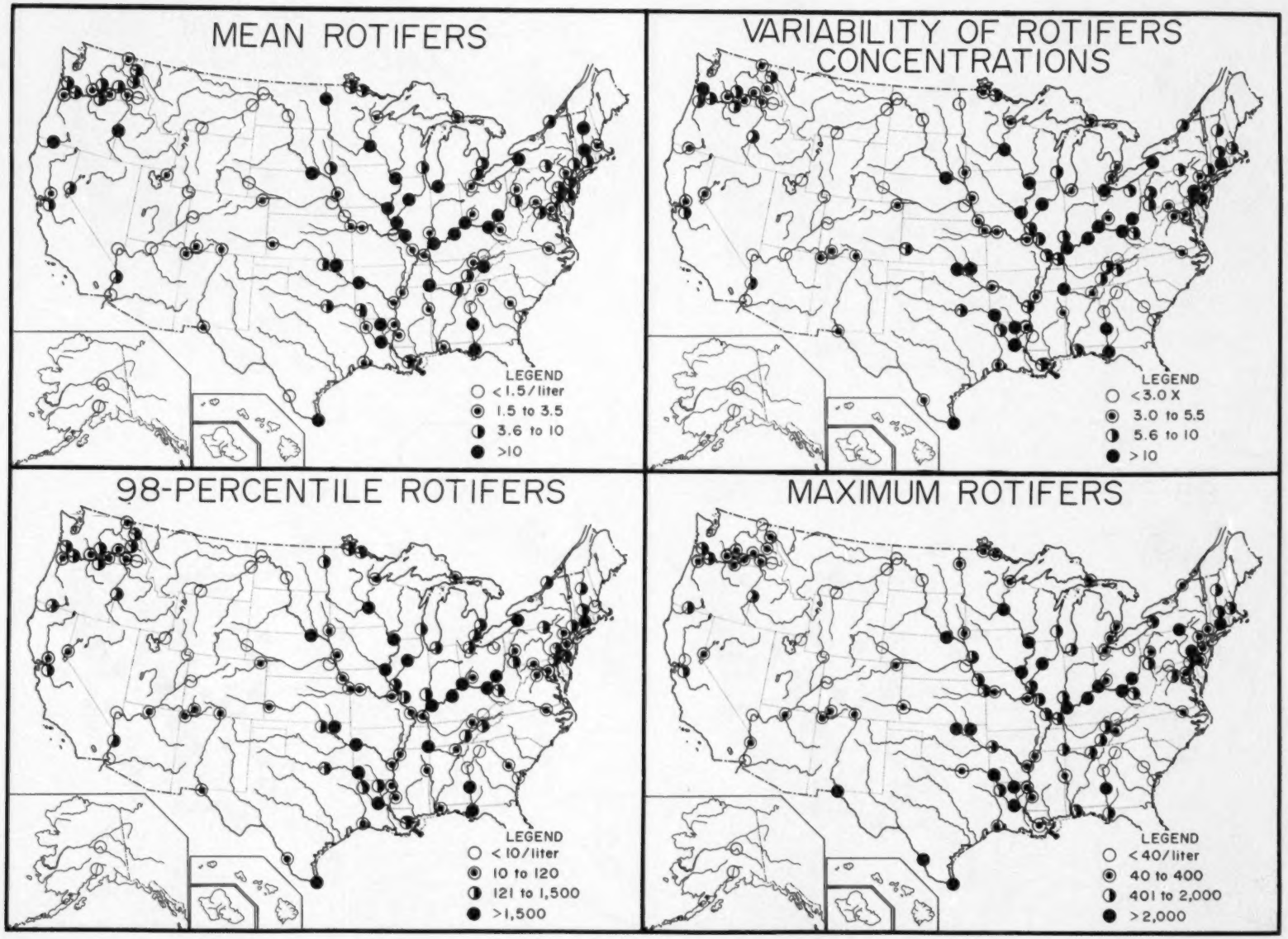


Figure 43. ROTIFERS.

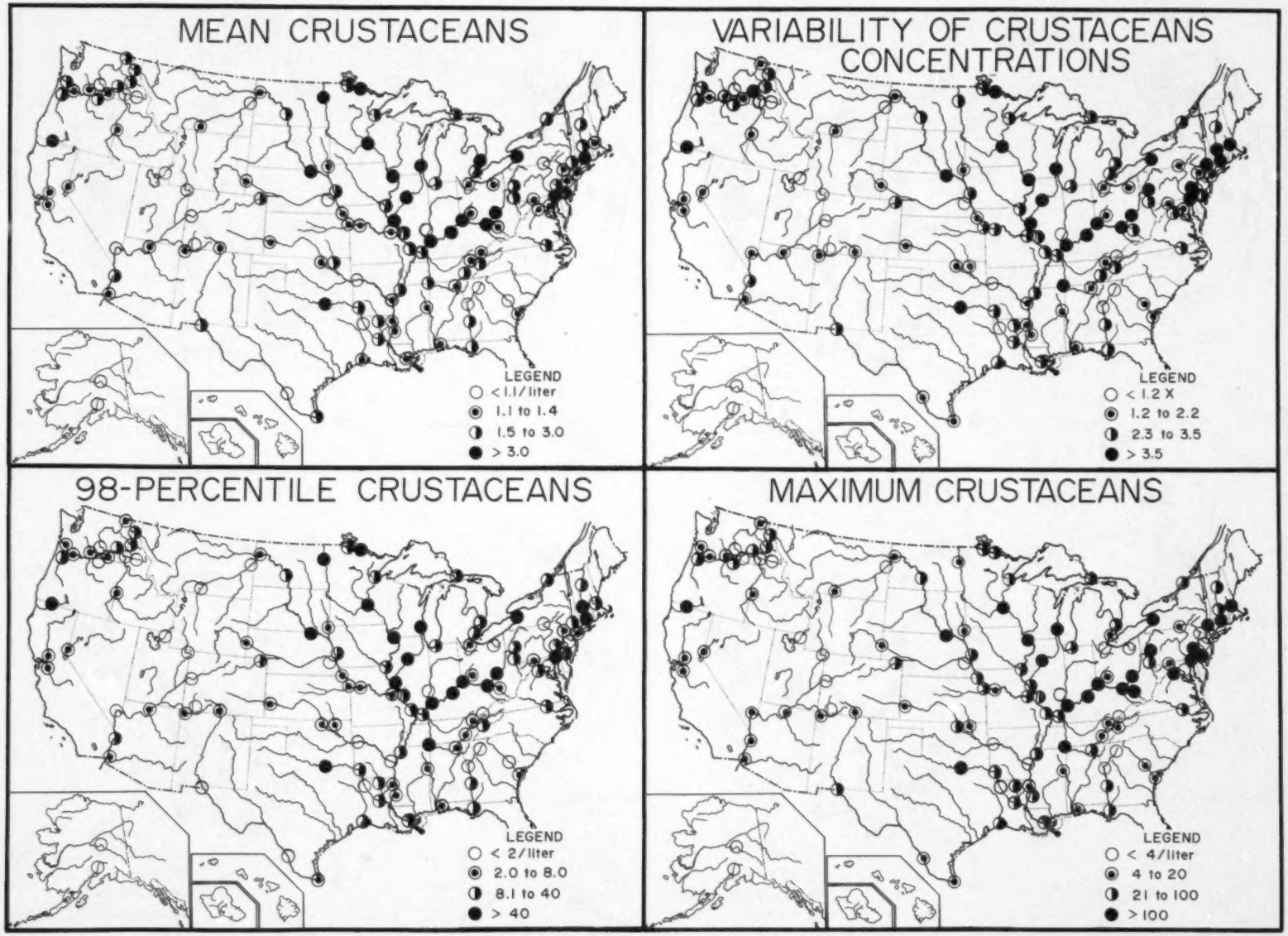


Figure 44. CRUSTACEANS.

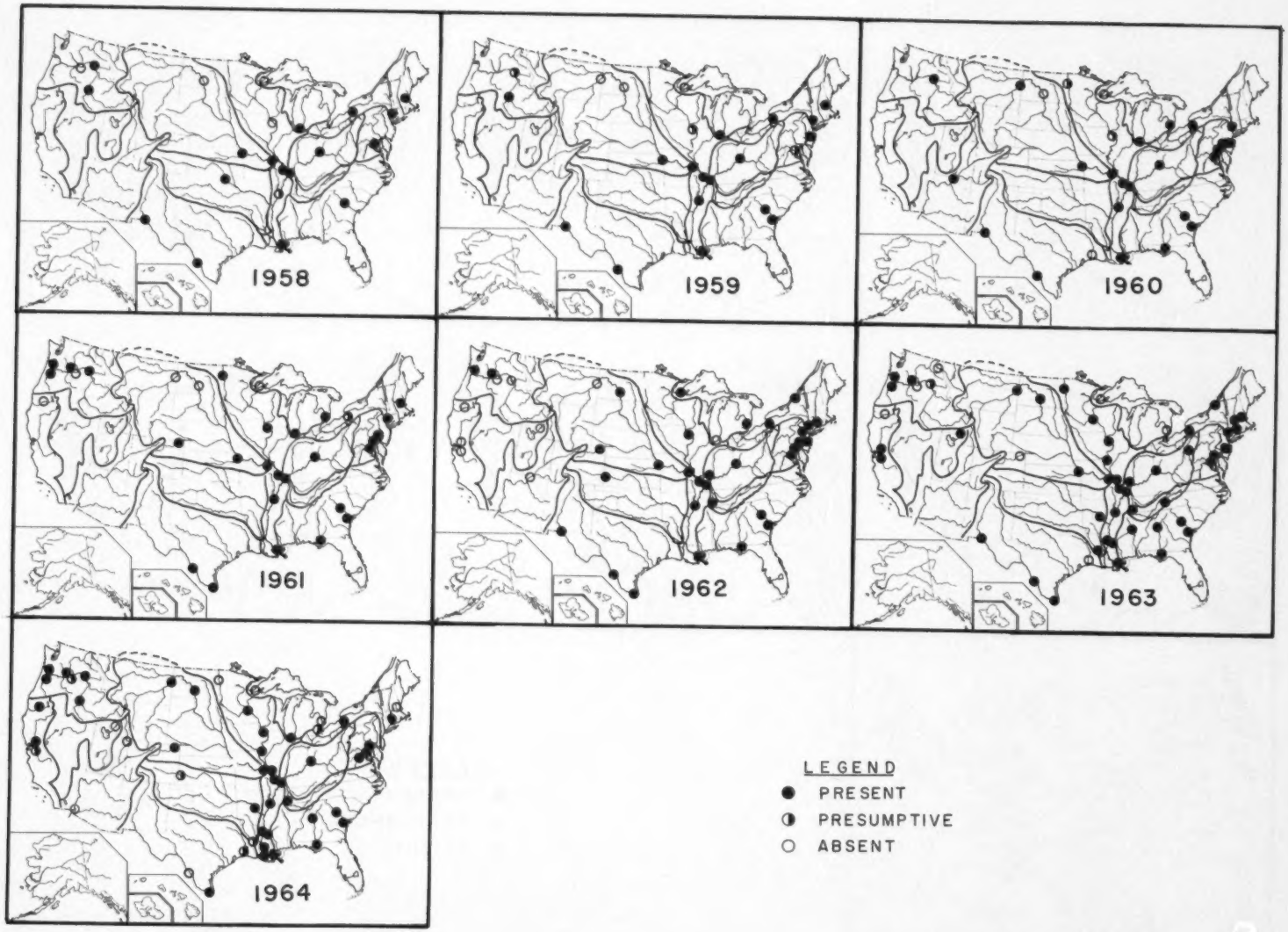


Figure 45. OCCURRENCE OF DIELDRIN IN CAM SAMPLES, WATER YEARS 1958 - 1964.

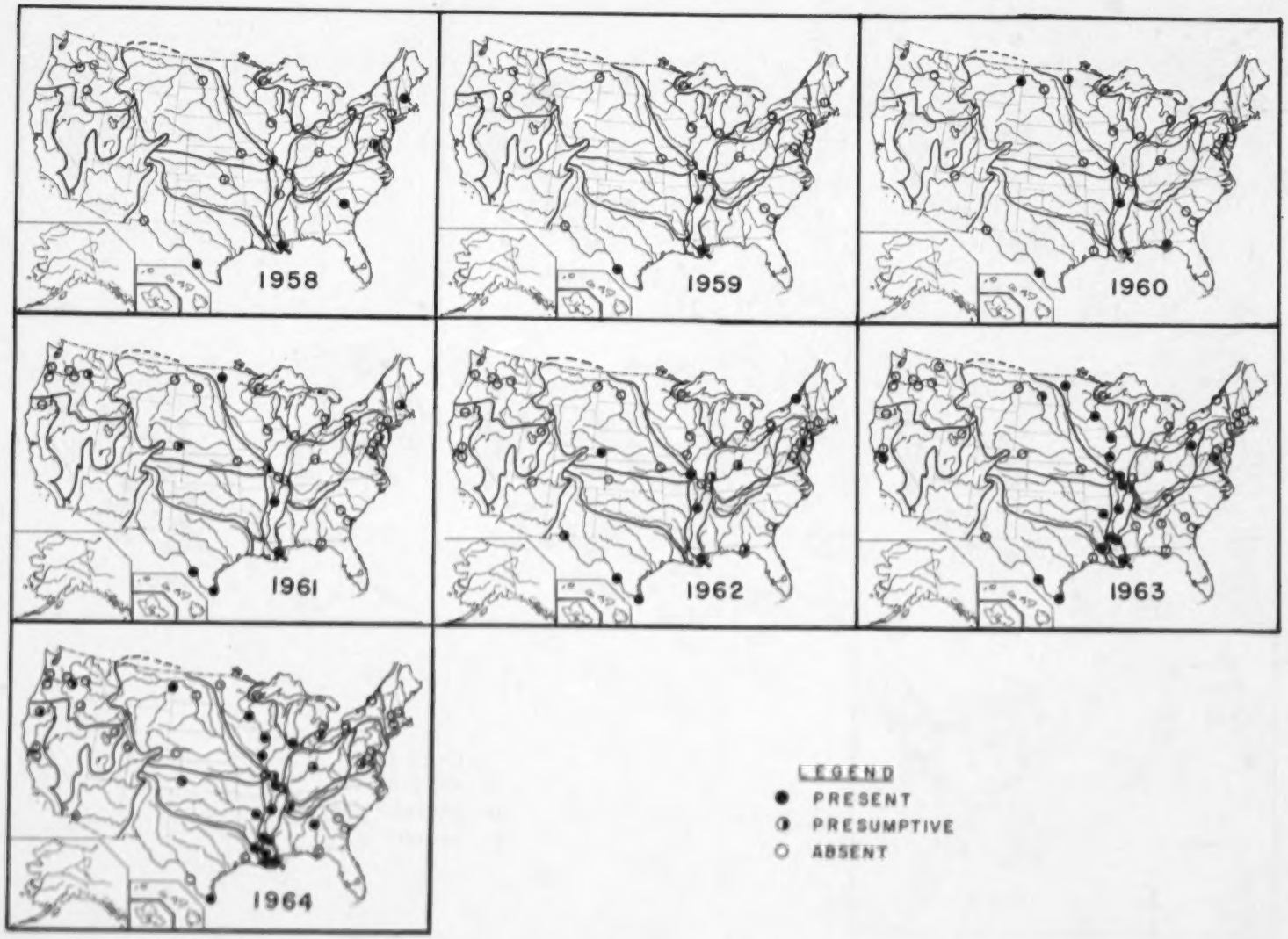


Figure 46. OCCURRENCE OF ENDRIN IN CAM SAMPLES, WATER YEARS 1958 - 1964.

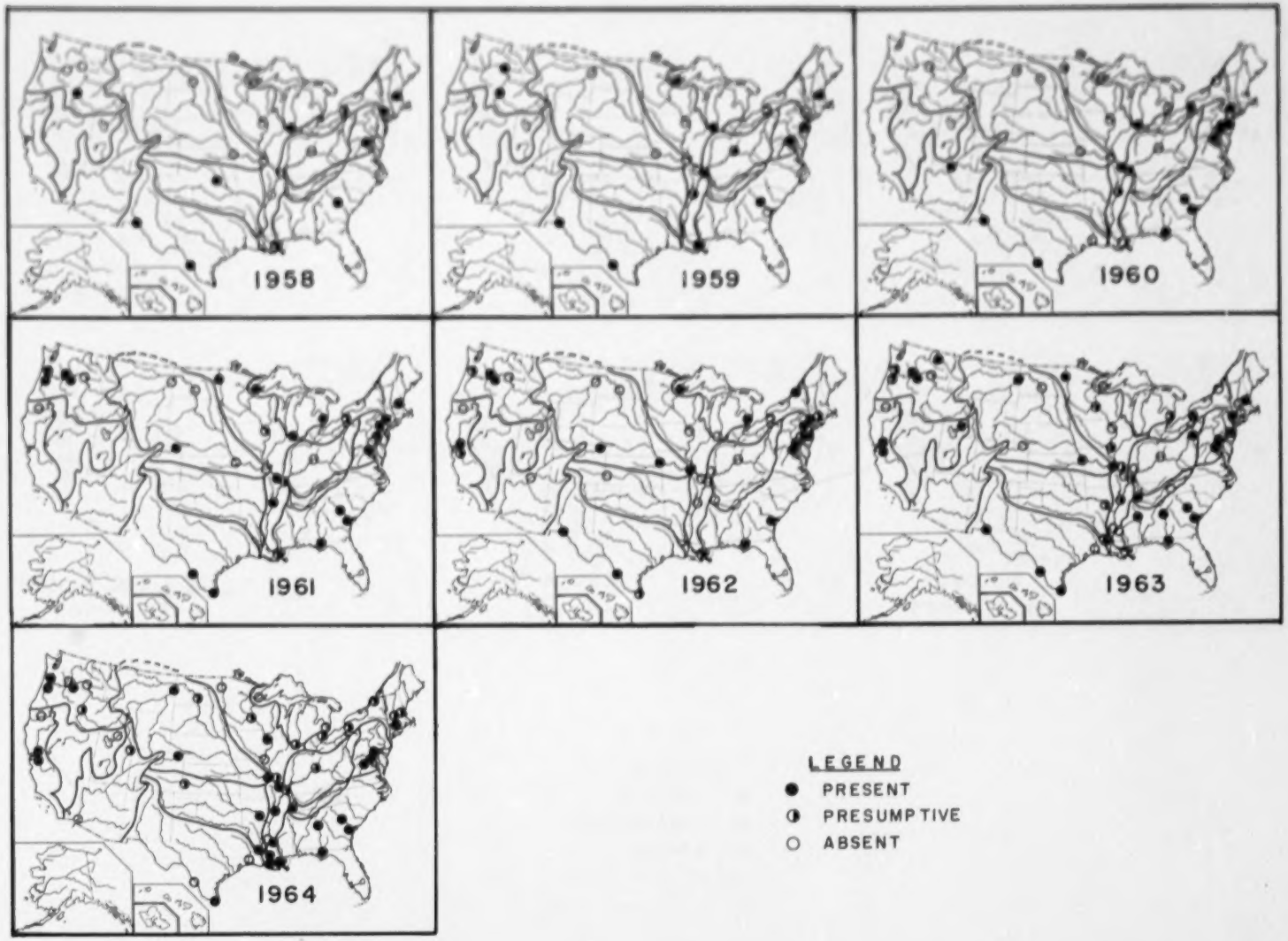


Figure 47. OCCURRENCE OF DDT, DDE, & DDD IN CAM SAMPLES, WATER YEARS 1958 - 1964.

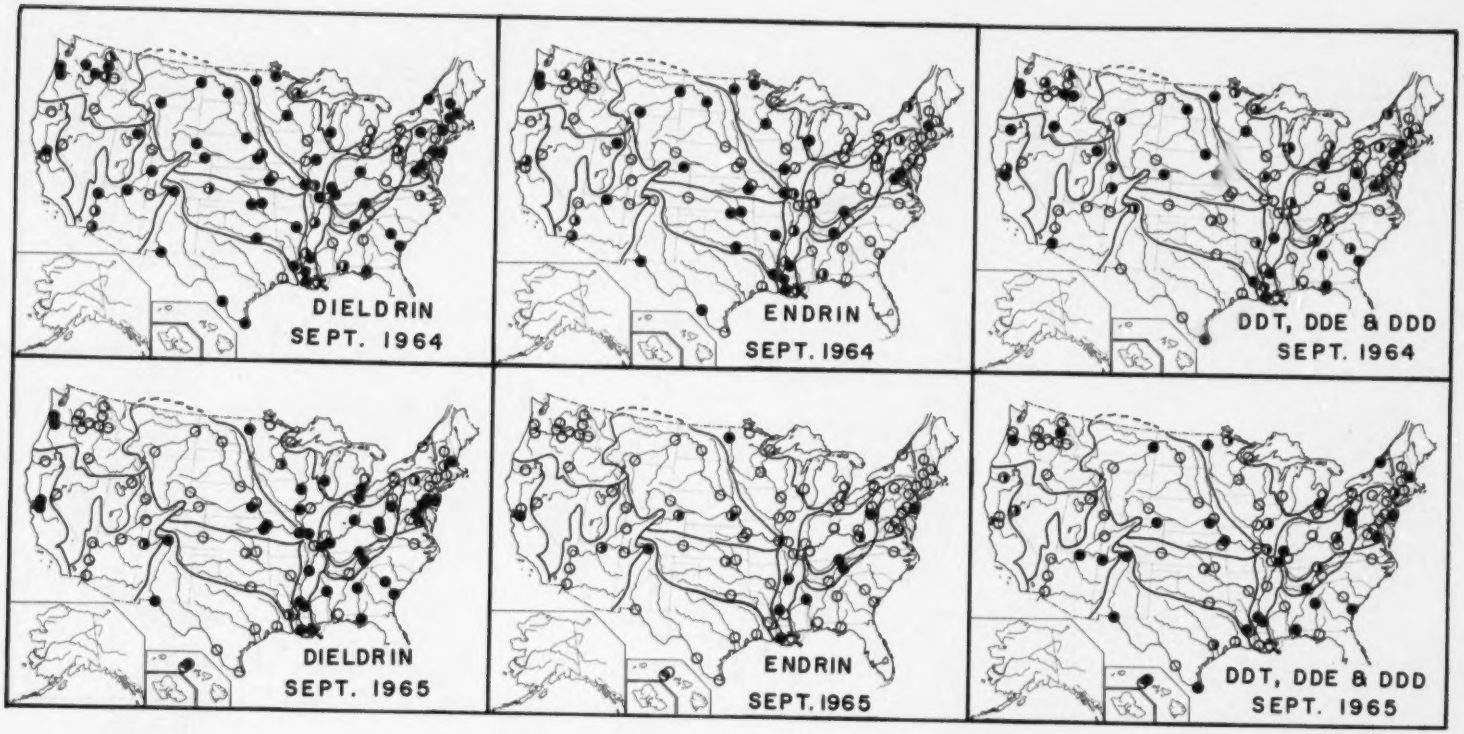


Figure 48. OCCURRENCE OF CHLORINATED HYDROCARBON PESTICIDES, SYNOPTIC SURVEYS OF 1964 AND 1965.